

# **PRELIMINARY HYDROLOGY AND HYDRAULIC REPORT**

**COUNTY OF SAN DIEGO TRACT #5479  
AT BUENA VISTA DR, VISTA CA  
APN 169-200-20**

**Prepared for:**

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March 27, 2013  
Revised September 11, 2013

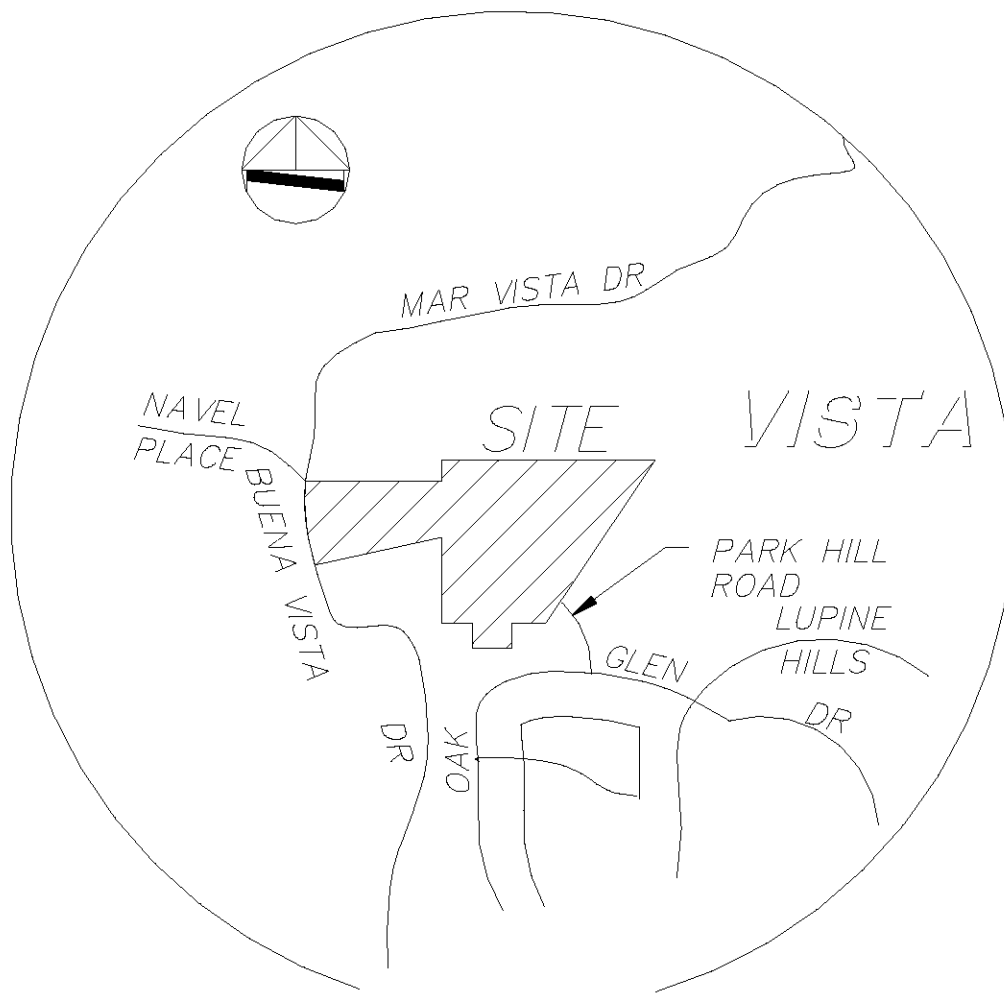
W.O. 943-1049-400

**SDC PDS RCVD 09-12-13  
TM5479RPL5**

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## I. DISCUSSION



***VICINITY MAP***  
NTS

## **PURPOSE AND SCOPE:**

The purpose of this report is to publish the results of hydrology and hydraulic computer analysis for the proposed development of Tract #5479 in the County of San Diego. The scope of this study is to analyze the results of existing and developed condition hydrology calculations and provide recommendations as to the design and size of various hydraulic systems considered as mitigation of any potential adverse effects of the proposed project. Proposed storm water drainage facilities include runoff interception ditches, curb inlets, catch basins, and bioretention basins. Information contained in this report will be referred to for the purpose of sizing treatment facilities as proposed in the associated Storm Water Management Plan (SWMP) for this site.

## **PROJECT DESCRIPTION:**

The project site is a 25.8- acre vacant lot (A. P. N 169-200-20) located on the east side of Buena Vista Drive and South of Mar Vista Drive in an unincorporated area of San Diego County that is bounded on all sides by the City of Vista. The project site is currently undeveloped, occupies south-facing and west-facing slopes of two natural drainage basins that split the property. On-site topography includes steep slopes to the south and the west with intermittent rock outcroppings, and elevations ranging from approximately 363 feet above mean sea level on the northern boundary at the northwest corner of the site, to approximately 509 feet above mean sea level on the northern boundary towards the northeast corner of the site. The project is located in the Los Monos Hydrologic Subarea (904.31), part of the Carlsbad Hydrologic Unit (904.00). The site soil quality is predominately Type-D, with small regions of Type-B and C soil. For this report, only Type-D soil will be considered. No contaminated or hazardous soil was located within the project area, and no evidence of scouring or excessive erosion resulting from concentrated runoff was in evidence at the site.

The proposed site is a 25.8-acre residential subdivision with 19 single family units with a minimum lot size of 0.5 acre, and a private road. The proposed drainage mimics the existing drainage pattern with regard to area and discharge points. The site will be approximately 14.7% impervious surface post-development. All site drainage will be routed 1 of 2 bioretention basins, sized for treatment and hydromodification per the County of San Diego SUSMP, see the SWMP report for this project. The basins serve to treat and discharge storm water runoff at or below pre-development flowrates, preventing any adverse affects downstream caused by the proposed development.

## **STUDY METHOD:**

The method of analysis was based on the Rational Method according to the San Diego County Hydrology Manual. The Hydrology and Hydraulic Analysis were done on Hydro Soft by Advanced Engineering Software 2007.

Drainage basin areas were determined from the topography and proposed grades shown on the



Tentative Map for this site and County of San Diego 200-Scale Topography Maps.

Included in the watershed area for this project is the runoff generated by the Gamboni Ranch subdivision, located to the southeast of the project site but ultimately sharing the same discharge point as this proposed development. The Hydrology Report for Gamboni Ranch was also performed by BHA, Inc., the results of which are referenced at its two recorded discharge locations and included in this report's Rational Method Calculations. Applicable pages of the Gamboni Ranch Hydrology Report have been included in the Calculations, section F of this report.

The Rational Method provided the following variable coefficients:

The soil conditions used in this study are consistent with Type-D soil qualities. Composite C-values were determined for drainage areas containing both pervious and impervious surfaces, see Table 1.0 below:

**Table 1.0:**

<b>Composite C-value Calculations</b>							
Up Node	Dwn Node	Total Acreage	C1	A1 (acres)	C2	A2 (acres)	Ccomp
<b>Existing Hydrology-</b>							
12	11	3.95	0.35	3.25	0.87	0.70	0.44
11	10	25.98	0.35	24.16	0.87	1.82	0.39
<b>Proposed Hydrology-</b>							
107	106	0.47	0.35	0.37	0.87	0.1	0.46
106	105	3.18	0.35	1.46	0.87	1.72	0.63
122	121	0.083	0.35	0.046	0.87	0.037	0.58
121	120	0.85	0.35	0.58	0.87	0.27	0.51
132	131	0.47	0.35	0.37	0.87	0.10	0.46
131	130	2.37	0.35	1.98	0.87	0.39	0.44
130	102	0.98	0.35	0.88	0.87	0.10	0.40
151	150	3.95	0.35	3.25	0.87	0.70	0.44
150	101	17.75	0.35	15.93	0.87	1.82	0.40
256	255	3.47	0.35	2.49	0.87	0.98	0.50
257	256	1.10	0.35	0.94	0.87	0.16	0.43

Note: C-values taken from Table 3-1 of San Diego County Hydrology Manual, consistent with on-site existing soil types from the USDA Web Soil Survey. See Appendix.

$$\text{Rainfall Intensity} = I = 7.44 \times (P6) \times (Tc)^{-0.645}$$

$$P6 \text{ for 100 year storm} = 3.2''$$

P24 for 100 Year Storm = 5.5"

Table 1.1 below summarizes the Results of the Rational Method Analysis:

**Table 1.1:**

<b>100 Year Storm Frequency, Summary of Hydrology Analysis Results</b>				
Basin		Existing	Proposed Undetained	Proposed Detained
1	Q (cfs)	41.58	36.91	31.41
	T (min)	19.59	19.97	19.97
	Acres	30.0	30.3	30.3
2	Q (cfs)	57.75	60.96	56.99
	T (min)	25.35	24.20	24.23
	Acres	52.2	51.8	51.8

The areas of Basin 1 and 2 differ by 0.3 acres from the existing to the proposed conditions. The site was graded to match the existing basin boundaries to the maximum extent practicable. However, with the lot sizes being 0.5 acres minimum, it was unfeasible to split the drainage from one single lot into 2 different watershed basins to make up the remaining acreage. Both this Hydrology Report and the SWMP Report for this project reflect these drainage basin limits.

## **CONCLUSION:**

The proposed storm drain system for this project adequately treats, mitigates, and conveys storm water runoff per the San Diego County HMP. The outlet flow from the proposed bioretention basins will achieve the required detention values, and discharge the 100-year storm at or below historical values. Sediment will be reduced upon site development.

### **DECLARATION OF RESPONSIBLE CHARGE**

I hereby declare that I am the Engineer of Work for this project, that I have exercised responsible charge over the design of the project as defined in section 6703 of the business and professions code, and that the design is consistent with current standards.

I understand that the check of project drawings and specifications by the County of San Diego is confined to a review only and does not relieve me, as Engineer of Work, of my responsibilities for project design.

---

Ron Holloway  
R.C.E. 29271

Date

## **II. EXHIBITS**

### **EXISTING & PROPOSED HYDROLOGY MAPS**

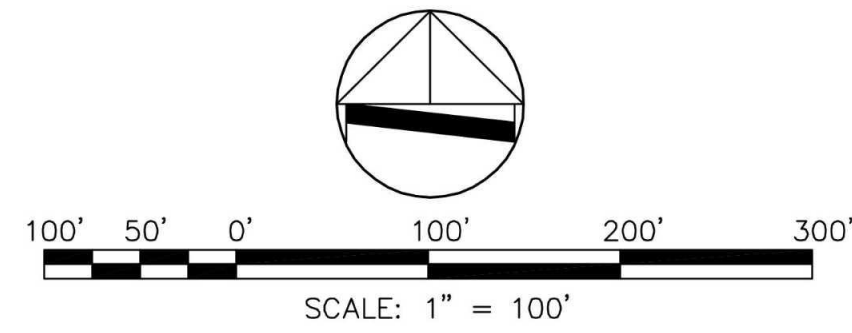


# LEGENDS

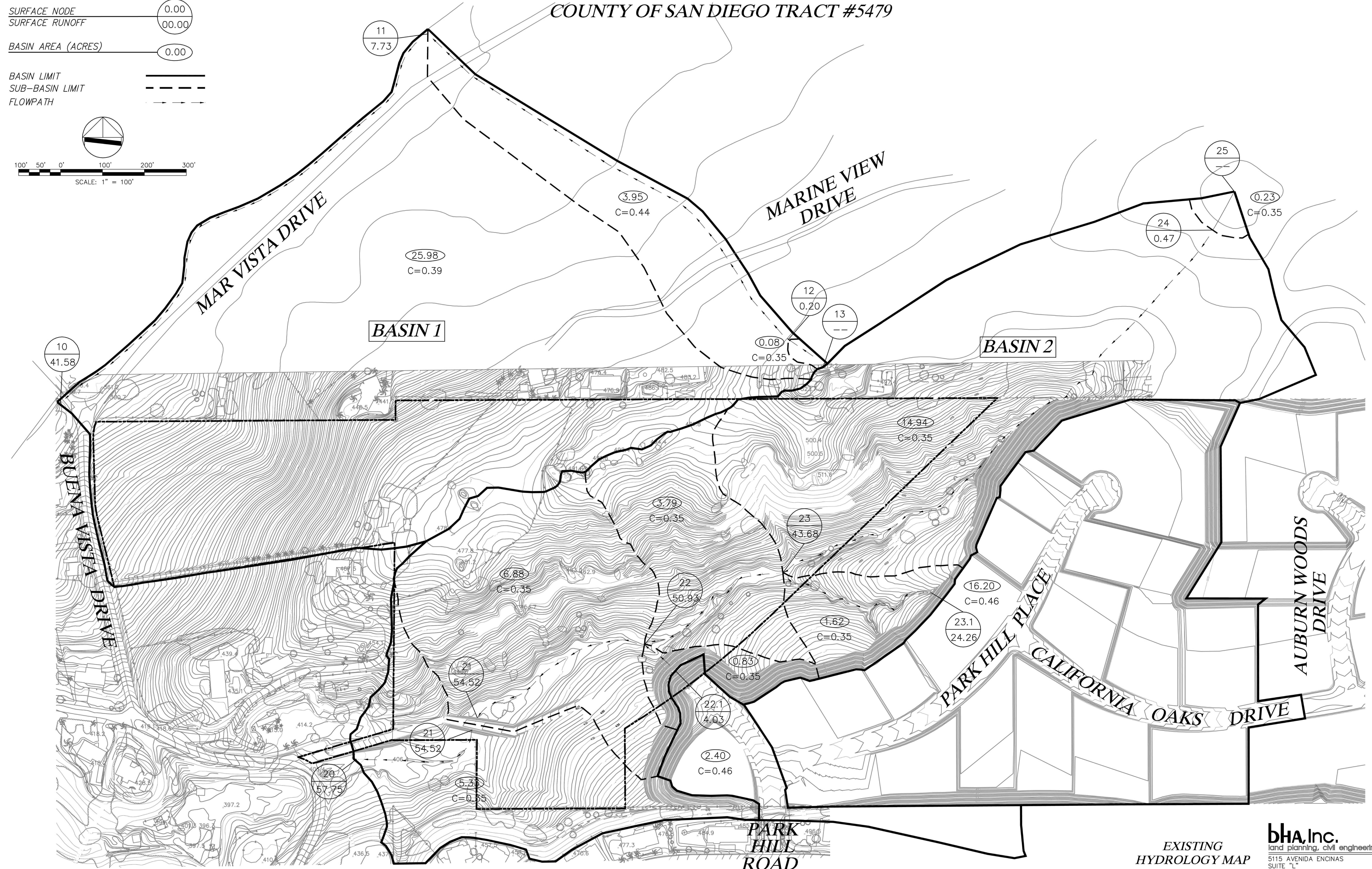
SURFACE NODE 0.00  
SURFACE RUNOFF 00.00

BASIN AREA (ACRES) 0.00

BASIN LIMIT  
SUB-BASIN LIMIT  
FLOWPATH



## EXISTING HYDROLOGY MAP COUNTY OF SAN DIEGO TRACT #5479



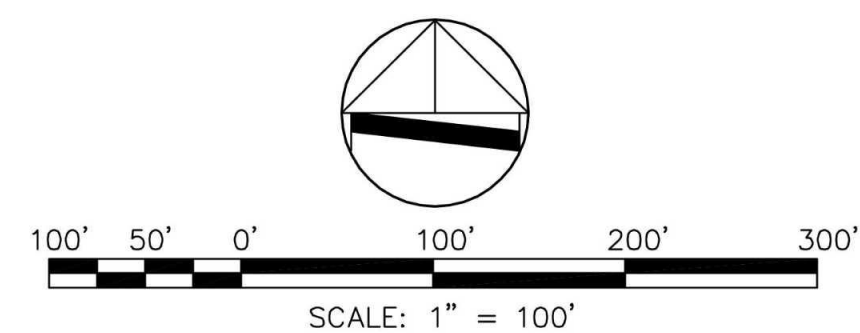
EXISTING  
HYDROLOGY MAP

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*PROPOSED HYDROLOGY MAP*  
*COUNTY OF SAN DIEGO TRACT #5479*

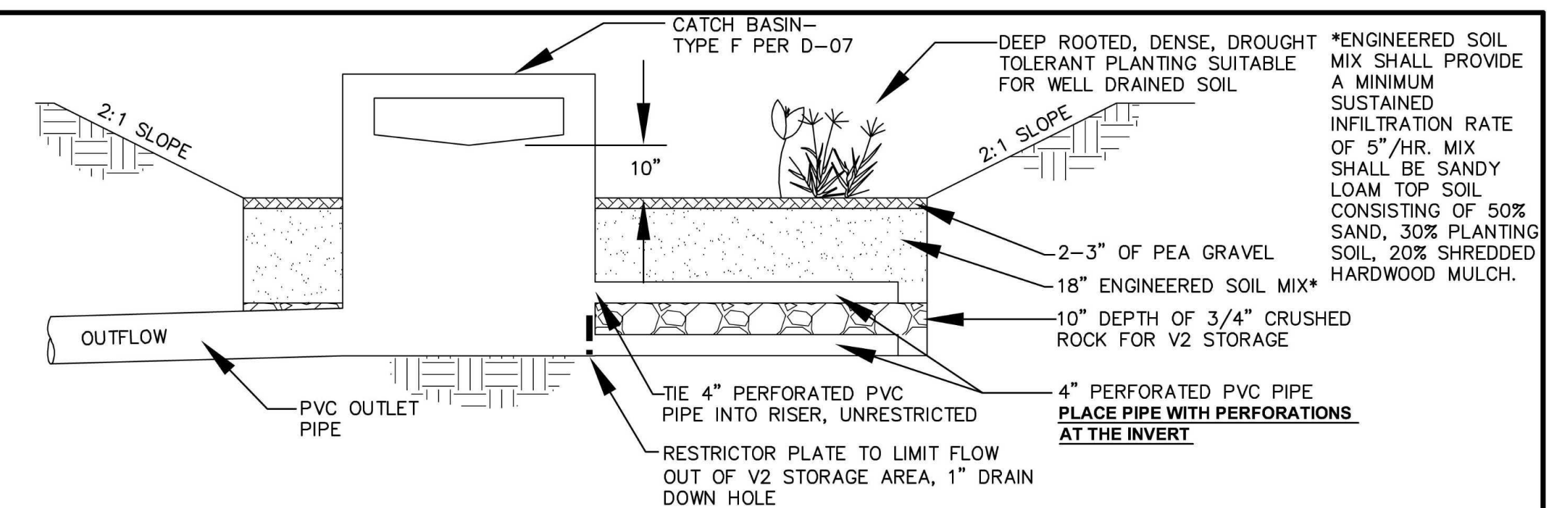
LOT NUMBER (19)



## BASIN 1

## BASIN 2

DETAILED Q100  
FLOWRATE AT NODE 200  
= 56.99 CFS



*BIORETENTION BASIN OUTLET DETAIL, TYP*

NOT TO SCALE

*PROPOSED  
HYDROLOGY MAP*

**bHA, Inc.**  
land planning, civil engineering, surveying

---

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### **III. CALCULATIONS**

#### **A. EXISTING 100-YEAR HYDROLOGY**

\*\*\*\*\*

RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE  
Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT  
2003,1985,1981 HYDROLOGY MANUAL  
(c) Copyright 1982-2012 Advanced Engineering Software (aes)  
Ver. 19.0 Release Date: 06/01/2012 License ID 1459

Analysis prepared by:

BHA Inc  
5115 Avenida Encinas, Suite L  
Carlsbad CA 92008

\*\*\*\*\* DESCRIPTION OF STUDY \*\*\*\*\*  
\* Existing Condition Hydrology Analysis \*  
\* 100 Year Storm Frequency \*  
\* \*  
\*\*\*\*\*

FILE NAME: 1049E100.DAT  
TIME/DATE OF STUDY: 12:45 01/15/2013

-----  
USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:  
-----

2003 SAN DIEGO MANUAL CRITERIA

USER SPECIFIED STORM EVENT(YEAR) = 100.00  
6-HOUR DURATION PRECIPITATION (INCHES) = 3.200  
SPECIFIED MINIMUM PIPE SIZE(INCH) = 3.00  
SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95  
SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD

NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS

\*USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL\*

	HALF- WIDTH	CROWN TO CROSSFALL	STREET-CROSSFALL: IN- / OUT- / PARK- SIDE / SIDE / WAY	CURB HEIGHT (FT)	GUTTER-GEOMETRIES: WIDTH (FT)	LIP (FT)	HIKE (FT)	MANNING FACTOR (n)
NO.	(FT)	(FT)						
===	=====	=====	=====	=====	=====	=====	=====	=====
1	30.0	20.0	0.018/0.018/0.020	0.67	2.00	0.0313	0.167	0.0150

GLOBAL STREET FLOW-DEPTH CONSTRAINTS:

1. Relative Flow-Depth = 0.00 FEET  
as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
2. (Depth)\*(Velocity) Constraint = 6.0 (FT\*FT/S)

\*SIZE PIPE WITH A FLOW CAPACITY GREATER THAN  
OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.\*

\*\*\*\*\*  
FLOW PROCESS FROM NODE 13.00 TO NODE 12.00 IS CODE = 21  
-----

>>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<

=====

\*USER SPECIFIED(SUBAREA):



```

USER-SPECIFIED RUNOFF COEFFICIENT = .3500
S.C.S. CURVE NUMBER (AMC II) = 0
INITIAL SUBAREA FLOW-LENGTH(FEET) = 100.00
UPSTREAM ELEVATION(FEET) = 517.20
DOWNSTREAM ELEVATION(FEET) = 502.00
ELEVATION DIFFERENCE(FEET) = 15.20
SUBAREA OVERLAND TIME OF FLOW(MIN.) = 6.267
WARNING: THE MAXIMUM OVERLAND FLOW SLOPE, 10.%, IS USED IN Tc CALCULATION!
100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 7.288
SUBAREA RUNOFF(CFS) = 0.20
TOTAL AREA(ACRES) = 0.08 TOTAL RUNOFF(CFS) = 0.20

```

\*\*\*\*\*

```

FLOW PROCESS FROM NODE 12.00 TO NODE 11.00 IS CODE = 51
-----

```

```

>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<
>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<
=====

```

```

ELEVATION DATA: UPSTREAM(FEET) = 502.00 DOWNSTREAM(FEET) = 375.00
CHANNEL LENGTH THRU SUBAREA(FEET) = 1249.00 CHANNEL SLOPE = 0.1017
CHANNEL BASE(FEET) = 10.00 "Z" FACTOR = 10.000
MANNING'S FACTOR = 0.040 MAXIMUM DEPTH(FEET) = 1.00
100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 4.377

```

\*USER SPECIFIED(SUBAREA):

```

USER-SPECIFIED RUNOFF COEFFICIENT = .4400
S.C.S. CURVE NUMBER (AMC II) = 0
TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) = 4.14
TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) = 2.76
AVERAGE FLOW DEPTH(FEET) = 0.13 TRAVEL TIME(MIN.) = 7.55
Tc(MIN.) = 13.82
SUBAREA AREA(ACRES) = 3.95 SUBAREA RUNOFF(CFS) = 7.61
AREA-AVERAGE RUNOFF COEFFICIENT = 0.438
TOTAL AREA(ACRES) = 4.0 PEAK FLOW RATE(CFS) = 7.73

```

END OF SUBAREA CHANNEL FLOW HYDRAULICS:

```

DEPTH(FEET) = 0.19 FLOW VELOCITY(FEET/SEC.) = 3.50
LONGEST FLOWPATH FROM NODE 13.00 TO NODE 11.00 = 1349.00 FEET.

```

\*\*\*\*\*

```

FLOW PROCESS FROM NODE 11.00 TO NODE 10.00 IS CODE = 51
-----

```

```

>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<
>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<
=====

```

```

ELEVATION DATA: UPSTREAM(FEET) = 375.00 DOWNSTREAM(FEET) = 357.80
CHANNEL LENGTH THRU SUBAREA(FEET) = 1298.00 CHANNEL SLOPE = 0.0133
CHANNEL BASE(FEET) = 2.00 "Z" FACTOR = 2.000
MANNING'S FACTOR = 0.040 MAXIMUM DEPTH(FEET) = 2.00
100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 3.494

```

\*USER SPECIFIED(SUBAREA):

```

USER-SPECIFIED RUNOFF COEFFICIENT = .3900
S.C.S. CURVE NUMBER (AMC II) = 0
TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) = 25.64
TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) = 3.75

```

AVERAGE FLOW DEPTH( FEET ) = 1.42 TRAVEL TIME( MIN. ) = 5.77  
Tc( MIN. ) = 19.59  
SUBAREA AREA( ACRES ) = 25.98 SUBAREA RUNOFF( CFS ) = 35.41  
AREA-AVERAGE RUNOFF COEFFICIENT = 0.396  
TOTAL AREA( ACRES ) = 30.0 PEAK FLOW RATE( CFS ) = 41.58

END OF SUBAREA CHANNEL FLOW HYDRAULICS:

DEPTH( FEET ) = 1.77 FLOW VELOCITY( FEET/SEC. ) = 4.25  
LONGEST FLOWPATH FROM NODE 13.00 TO NODE 10.00 = 2647.00 FEET.

\*\*\*\*\*

FLOW PROCESS FROM NODE 25.00 TO NODE 24.00 IS CODE = 21

-----  
>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<

=====

\*USER SPECIFIED( SUBAREA ):

USER-SPECIFIED RUNOFF COEFFICIENT = .3500  
S.C.S. CURVE NUMBER (AMC II) = 0  
INITIAL SUBAREA FLOW-LENGTH( FEET ) = 100.00  
UPSTREAM ELEVATION( FEET ) = 526.50  
DOWNSTREAM ELEVATION( FEET ) = 523.00  
ELEVATION DIFFERENCE( FEET ) = 3.50  
SUBAREA OVERLAND TIME OF FLOW( MIN. ) = 8.892  
100 YEAR RAINFALL INTENSITY( INCH/HOUR ) = 5.816  
SUBAREA RUNOFF( CFS ) = 0.47  
TOTAL AREA( ACRES ) = 0.23 TOTAL RUNOFF( CFS ) = 0.47

\*\*\*\*\*

FLOW PROCESS FROM NODE 24.00 TO NODE 23.00 IS CODE = 51

-----  
>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<

>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<

=====

ELEVATION DATA: UPSTREAM( FEET ) = 523.00 DOWNSTREAM( FEET ) = 430.90  
CHANNEL LENGTH THRU SUBAREA( FEET ) = 1356.00 CHANNEL SLOPE = 0.0679  
CHANNEL BASE( FEET ) = 10.00 "Z" FACTOR = 5.000  
MANNING'S FACTOR = 0.040 MAXIMUM DEPTH( FEET ) = 5.00  
100 YEAR RAINFALL INTENSITY( INCH/HOUR ) = 4.173

\*USER SPECIFIED( SUBAREA ):

USER-SPECIFIED RUNOFF COEFFICIENT = .3500  
S.C.S. CURVE NUMBER (AMC II) = 0  
TRAVEL TIME COMPUTED USING ESTIMATED FLOW( CFS ) = 11.66  
TRAVEL TIME THRU SUBAREA BASED ON VELOCITY( FEET/SEC. ) = 3.78  
AVERAGE FLOW DEPTH( FEET ) = 0.27 TRAVEL TIME( MIN. ) = 5.99  
Tc( MIN. ) = 14.88  
SUBAREA AREA( ACRES ) = 14.94 SUBAREA RUNOFF( CFS ) = 21.82  
AREA-AVERAGE RUNOFF COEFFICIENT = 0.350  
TOTAL AREA( ACRES ) = 15.2 PEAK FLOW RATE( CFS ) = 22.16

END OF SUBAREA CHANNEL FLOW HYDRAULICS:

DEPTH( FEET ) = 0.39 FLOW VELOCITY( FEET/SEC. ) = 4.70  
LONGEST FLOWPATH FROM NODE 25.00 TO NODE 23.00 = 1456.00 FEET.

\*\*\*\*\*

```

FLOW PROCESS FROM NODE      24.00 TO NODE      23.00 IS CODE =    1
-----
>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
=====
TOTAL NUMBER OF STREAMS =    2
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
TIME OF CONCENTRATION(MIN.) =   14.88
RAINFALL INTENSITY(INCH/HR) =    4.17
TOTAL STREAM AREA(ACRES) =   15.17
PEAK FLOW RATE(CFS) AT CONFLUENCE =   22.16

*****
FLOW PROCESS FROM NODE      23.20 TO NODE      23.10 IS CODE =   21
-----
>>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
=====
*USER SPECIFIED(SUBAREA):
USER-SPECIFIED RUNOFF COEFFICIENT = .3500
S.C.S. CURVE NUMBER (AMC II) =    0
INITIAL SUBAREA FLOW-LENGTH(FEET) =    0.01
UPSTREAM ELEVATION(FEET) =   455.10
DOWNSTREAM ELEVATION(FEET) =   455.00
ELEVATION DIFFERENCE(FEET) =    0.10
SUBAREA OVERLAND TIME OF FLOW(MIN.) =    0.063
WARNING: THE MAXIMUM OVERLAND FLOW SLOPE, 10.%, IS USED IN Tc CALCULATION!
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  8.431
NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
SUBAREA RUNOFF(CFS) =    0.30
TOTAL AREA(ACRES) =    0.10  TOTAL RUNOFF(CFS) =    0.30

*****
FLOW PROCESS FROM NODE      23.20 TO NODE      23.10 IS CODE =    7
-----
>>>>>USER SPECIFIED HYDROLOGY INFORMATION AT NODE<<<<<
=====
USER-SPECIFIED VALUES ARE AS FOLLOWS:
TC(MIN) =  18.12  RAIN INTENSITY(INCH/HOUR) =  3.67
TOTAL AREA(ACRES) =  16.20  TOTAL RUNOFF(CFS) =  24.26

*****
FLOW PROCESS FROM NODE      23.10 TO NODE      23.00 IS CODE =   51
-----
>>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
>>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) =   455.00  DOWNSTREAM(FEET) =   430.90
CHANNEL LENGTH THRU SUBAREA(FEET) =  400.00  CHANNEL SLOPE =  0.0603
CHANNEL BASE(FEET) =  10.00  "Z" FACTOR =  5.000
MANNING'S FACTOR = 0.040  MAXIMUM DEPTH(FEET) =  2.00
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.501
*USER SPECIFIED(SUBAREA):
USER-SPECIFIED RUNOFF COEFFICIENT = .3500
S.C.S. CURVE NUMBER (AMC II) =    0
TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =   25.25

```

TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) = 4.71  
 AVERAGE FLOW DEPTH(FEET) = 0.44 TRAVEL TIME(MIN.) = 1.42  
 Tc(MIN.) = 19.54  
 SUBAREA AREA(ACRES) = 1.62 SUBAREA RUNOFF(CFS) = 1.98  
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.402  
 TOTAL AREA(ACRES) = 17.8 PEAK FLOW RATE(CFS) = 25.10

END OF SUBAREA CHANNEL FLOW HYDRAULICS:  
 DEPTH(FEET) = 0.44 FLOW VELOCITY(FEET/SEC.) = 4.70  
 LONGEST FLOWPATH FROM NODE 23.20 TO NODE 23.00 = 400.01 FEET.

\*\*\*\*\*  
 FLOW PROCESS FROM NODE 23.10 TO NODE 23.00 IS CODE = 1

>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<  
 >>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<

=====

TOTAL NUMBER OF STREAMS = 2  
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 2 ARE:  
 TIME OF CONCENTRATION(MIN.) = 19.54  
 RAINFALL INTENSITY(INCH/HR) = 3.50  
 TOTAL STREAM AREA(ACRES) = 17.82  
 PEAK FLOW RATE(CFS) AT CONFLUENCE = 25.10

\*\* CONFLUENCE DATA \*\*

STREAM NUMBER	RUNOFF (CFS)	Tc (MIN.)	INTENSITY (INCH/HOUR)	AREA (ACRE)
1	22.16	14.88	4.173	15.17
2	25.10	19.54	3.501	17.82

RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO  
 CONFLUENCE FORMULA USED FOR 2 STREAMS.

\*\* PEAK FLOW RATE TABLE \*\*

STREAM NUMBER	RUNOFF (CFS)	Tc (MIN.)	INTENSITY (INCH/HOUR)
1	41.27	14.88	4.173
2	43.68	19.54	3.501

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:  
 PEAK FLOW RATE(CFS) = 43.68 Tc(MIN.) = 19.54  
 TOTAL AREA(ACRES) = 33.0  
 LONGEST FLOWPATH FROM NODE 25.00 TO NODE 23.00 = 1456.00 FEET.

\*\*\*\*\*  
 FLOW PROCESS FROM NODE 23.00 TO NODE 22.00 IS CODE = 51

>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<  
 >>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<

=====

ELEVATION DATA: UPSTREAM(FEET) = 430.90 DOWNSTREAM(FEET) = 419.00  
 CHANNEL LENGTH THRU SUBAREA(FEET) = 395.00 CHANNEL SLOPE = 0.0301  
 CHANNEL BASE(FEET) = 10.00 "Z" FACTOR = 5.000  
 MANNING'S FACTOR = 0.040 MAXIMUM DEPTH(FEET) = 2.00

```

100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 3.341
*USER SPECIFIED(SUBAREA):
USER-SPECIFIED RUNOFF COEFFICIENT = .3500
S.C.S. CURVE NUMBER (AMC II) = 0
TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) = 45.90
TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) = 4.49
AVERAGE FLOW DEPTH(FEET) = 0.74 TRAVEL TIME(MIN.) = 1.47
Tc(MIN.) = 21.00
SUBAREA AREA(ACRES) = 3.79 SUBAREA RUNOFF(CFS) = 4.43
AREA-AVERAGE RUNOFF COEFFICIENT = 0.375
TOTAL AREA(ACRES) = 36.8 PEAK FLOW RATE(CFS) = 46.12

END OF SUBAREA CHANNEL FLOW HYDRAULICS:
DEPTH(FEET) = 0.74 FLOW VELOCITY(FEET/SEC.) = 4.51
LONGEST FLOWPATH FROM NODE 25.00 TO NODE 22.00 = 1851.00 FEET.

*****
FLOW PROCESS FROM NODE 23.00 TO NODE 22.00 IS CODE = 1
-----
>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<
=====
TOTAL NUMBER OF STREAMS = 2
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 1 ARE:
TIME OF CONCENTRATION(MIN.) = 21.00
RAINFALL INTENSITY(INCH/HR) = 3.34
TOTAL STREAM AREA(ACRES) = 36.78
PEAK FLOW RATE(CFS) AT CONFLUENCE = 46.12

*****
FLOW PROCESS FROM NODE 22.20 TO NODE 22.10 IS CODE = 21
-----
>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<
=====
*USER SPECIFIED(SUBAREA):
USER-SPECIFIED RUNOFF COEFFICIENT = .3500
S.C.S. CURVE NUMBER (AMC II) = 0
INITIAL SUBAREA FLOW-LENGTH(FEET) = 0.01
UPSTREAM ELEVATION(FEET) = 445.10
DOWNSTREAM ELEVATION(FEET) = 445.00
ELEVATION DIFFERENCE(FEET) = 0.10
SUBAREA OVERLAND TIME OF FLOW(MIN.) = 0.063
WARNING: THE MAXIMUM OVERLAND FLOW SLOPE, 10.%, IS USED IN Tc CALCULATION!
100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 8.431
NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
SUBAREA RUNOFF(CFS) = 0.30
TOTAL AREA(ACRES) = 0.10 TOTAL RUNOFF(CFS) = 0.30

*****
FLOW PROCESS FROM NODE 22.20 TO NODE 22.10 IS CODE = 7
-----
>>>>USER SPECIFIED HYDROLOGY INFORMATION AT NODE<<<<
=====
USER-SPECIFIED VALUES ARE AS FOLLOWS:
TC(MIN) = 19.49 RAIN INTENSITY(INCH/HOUR) = 3.51

```

TOTAL AREA(ACRES) = 2.40 TOTAL RUNOFF(CFS) = 4.03

\*\*\*\*\*

FLOW PROCESS FROM NODE 22.10 TO NODE 22.00 IS CODE = 51

>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<

>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<

ELEVATION DATA: UPSTREAM(FEET) = 445.00 DOWNSTREAM(FEET) = 419.00

CHANNEL LENGTH THRU SUBAREA(FEET) = 98.00 CHANNEL SLOPE = 0.2653

CHANNEL BASE(FEET) = 0.00 "Z" FACTOR = 2.000

MANNING'S FACTOR = 0.015 MAXIMUM DEPTH(FEET) = 1.00

100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 3.494

\*USER SPECIFIED(SUBAREA):

USER-SPECIFIED RUNOFF COEFFICIENT = .3500

S.C.S. CURVE NUMBER (AMC II) = 0

TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) = 4.54

TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) = 15.83

AVERAGE FLOW DEPTH(FEET) = 0.38 TRAVEL TIME(MIN.) = 0.10

Tc(MIN.) = 19.59

SUBAREA AREA(ACRES) = 0.83 SUBAREA RUNOFF(CFS) = 1.01

AREA-AVERAGE RUNOFF COEFFICIENT = 0.446

TOTAL AREA(ACRES) = 3.2 PEAK FLOW RATE(CFS) = 5.03

END OF SUBAREA CHANNEL FLOW HYDRAULICS:

DEPTH(FEET) = 0.39 FLOW VELOCITY(FEET/SEC.) = 16.22

LONGEST FLOWPATH FROM NODE 22.20 TO NODE 22.00 = 98.01 FEET.

\*\*\*\*\*

FLOW PROCESS FROM NODE 22.10 TO NODE 22.00 IS CODE = 1

>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<

>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<

TOTAL NUMBER OF STREAMS = 2

CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 2 ARE:

TIME OF CONCENTRATION(MIN.) = 19.59

RAINFALL INTENSITY(INCH/HR) = 3.49

TOTAL STREAM AREA(ACRES) = 3.23

PEAK FLOW RATE(CFS) AT CONFLUENCE = 5.03

\*\* CONFLUENCE DATA \*\*

STREAM NUMBER	RUNOFF (CFS)	Tc (MIN.)	INTENSITY (INCH/HOUR)	AREA (ACRE)
1	46.12	21.00	3.341	36.78
2	5.03	19.59	3.494	3.23

RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO

CONFLUENCE FORMULA USED FOR 2 STREAMS.

\*\* PEAK FLOW RATE TABLE \*\*

STREAM NUMBER	RUNOFF (CFS)	Tc (MIN.)	INTENSITY (INCH/HOUR)
1	49.13	19.59	3.494

2            50.93        21.00            3.341

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:

PEAK FLOW RATE(CFS) =        50.93        Tc(MIN.) =        21.00

TOTAL AREA(ACRES) =        40.0

LONGEST FLOWPATH FROM NODE        25.00 TO NODE        22.00 =        1851.00 FEET.

\*\*\*\*\*

FLOW PROCESS FROM NODE        22.00 TO NODE        21.00 IS CODE =    51

-----  
>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<

>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<

=====

ELEVATION DATA: UPSTREAM(FEET) =        419.00        DOWNSTREAM(FEET) =        411.00

CHANNEL LENGTH THRU SUBAREA(FEET) =        458.00        CHANNEL SLOPE =        0.0175

CHANNEL BASE(FEET) =        40.00        "Z" FACTOR =        5.000

MANNING'S FACTOR = 0.040        MAXIMUM DEPTH(FEET) =        5.00

100 YEAR RAINFALL INTENSITY(INCH/HOUR) =        3.088

\*USER SPECIFIED(SUBAREA):

USER-SPECIFIED RUNOFF COEFFICIENT = .3500

S.C.S. CURVE NUMBER (AMC II) =        0

TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =        54.65

TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =        2.80

AVERAGE FLOW DEPTH(FEET) =        0.46        TRAVEL TIME(MIN.) =        2.72

Tc(MIN.) =        23.72

SUBAREA AREA(ACRES) =        6.88        SUBAREA RUNOFF(CFS) =        7.44

AREA-AVERAGE RUNOFF COEFFICIENT =        0.376

TOTAL AREA(ACRES) =        46.9        PEAK FLOW RATE(CFS) =        54.52

END OF SUBAREA CHANNEL FLOW HYDRAULICS:

DEPTH(FEET) = 0.46        FLOW VELOCITY(FEET/SEC.) =        2.80

LONGEST FLOWPATH FROM NODE        25.00 TO NODE        21.00 =        2309.00 FEET.

\*\*\*\*\*

FLOW PROCESS FROM NODE        21.00 TO NODE        21.10 IS CODE =    41

-----  
>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<

>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<

=====

ELEVATION DATA: UPSTREAM(FEET) =        411.00        DOWNSTREAM(FEET) =        410.40

FLOW LENGTH(FEET) =        30.00        MANNING'S N =        0.013

DEPTH OF FLOW IN 27.0 INCH PIPE IS 15.7 INCHES

PIPE-FLOW VELOCITY(FEET/SEC.) =        11.38

GIVEN PIPE DIAMETER(INCH) =        27.00        NUMBER OF PIPES =        2

PIPE-FLOW(CFS) =        54.52

PIPE TRAVEL TIME(MIN.) =        0.04        Tc(MIN.) =        23.77

LONGEST FLOWPATH FROM NODE        25.00 TO NODE        21.10 =        2339.00 FEET.

\*\*\*\*\*

FLOW PROCESS FROM NODE        21.10 TO NODE        20.00 IS CODE =    51

-----  
>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<

>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<

ELEVATION DATA: UPSTREAM( FEET ) = 410.40 DOWNSTREAM( FEET ) = 404.00  
 CHANNEL LENGTH THRU SUBAREA( FEET ) = 320.00 CHANNEL SLOPE = 0.0200  
 CHANNEL BASE( FEET ) = 30.00 "Z" FACTOR = 3.000  
 MANNING'S FACTOR = 0.040 MAXIMUM DEPTH( FEET ) = 5.00  
 100 YEAR RAINFALL INTENSITY( INCH/HOUR ) = 2.959

\*USER SPECIFIED( SUBAREA ):

USER-SPECIFIED RUNOFF COEFFICIENT = .3500

S.C.S. CURVE NUMBER ( AMC II ) = 0

TRAVEL TIME COMPUTED USING ESTIMATED FLOW( CFS ) = 57.28

TRAVEL TIME THRU SUBAREA BASED ON VELOCITY( FEET/SEC. ) = 3.36

AVERAGE FLOW DEPTH( FEET ) = 0.54 TRAVEL TIME( MIN. ) = 1.59

Tc( MIN. ) = 25.35

SUBAREA AREA( ACRES ) = 5.33 SUBAREA RUNOFF( CFS ) = 5.52

AREA-AVERAGE RUNOFF COEFFICIENT = 0.374

TOTAL AREA( ACRES ) = 52.2 PEAK FLOW RATE( CFS ) = 57.75

END OF SUBAREA CHANNEL FLOW HYDRAULICS:

DEPTH( FEET ) = 0.54 FLOW VELOCITY( FEET/SEC. ) = 3.35

LONGEST FLOWPATH FROM NODE 25.00 TO NODE 20.00 = 2659.00 FEET.

=====

END OF STUDY SUMMARY:

TOTAL AREA( ACRES ) = 52.2 TC( MIN. ) = 25.35

PEAK FLOW RATE( CFS ) = 57.75

=====

END OF RATIONAL METHOD ANALYSIS



**B. PROPOSED UNDETAINED 100-YEAR HYDROLOGY**

\*\*\*\*\*

RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE  
Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT  
2003,1985,1981 HYDROLOGY MANUAL  
(c) Copyright 1982-2012 Advanced Engineering Software (aes)  
Ver. 19.0 Release Date: 06/01/2012 License ID 1459

Analysis prepared by:

BHA Inc  
5115 Avenida Encinas, Suite L  
Carlsbad CA 92008

\*\*\*\*\* DESCRIPTION OF STUDY \*\*\*\*\*  
\* Proposed Undetained Condition Hydrology Analysis \*  
\* 100 Year Storm Frequency \*  
\* \*  
\*\*\*\*\*

FILE NAME: 1049P100.DAT  
TIME/DATE OF STUDY: 13:20 01/22/2013

-----  
USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:  
-----

2003 SAN DIEGO MANUAL CRITERIA

USER SPECIFIED STORM EVENT(YEAR) = 100.00  
6-HOUR DURATION PRECIPITATION (INCHES) = 3.200  
SPECIFIED MINIMUM PIPE SIZE(INCH) = 3.00  
SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95  
SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD  
NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS  
\*USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL\*  
    HALF- CROWN TO STREET-CROSSFALL: CURB GUTTER-GEOMETRIES: MANNING  
    WIDTH CROSSFALL IN- / OUT-/PARK- HEIGHT WIDTH LIP HIKE FACTOR  
NO. (FT) (FT) SIDE / SIDE/ WAY (FT) (FT) (FT) (FT) (n)  
== =====  
1 30.0 20.0 0.018/0.018/0.020 0.67 2.00 0.0313 0.167 0.0150

GLOBAL STREET FLOW-DEPTH CONSTRAINTS:

1. Relative Flow-Depth = 0.00 FEET  
as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
  2. (Depth)\*(Velocity) Constraint = 6.0 (FT\*FT/S)
- \*SIZE PIPE WITH A FLOW CAPACITY GREATER THAN  
OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.\*

\*\*\*\*\*  
FLOW PROCESS FROM NODE 108.00 TO NODE 107.00 IS CODE = 21  
-----

>>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<

=====

\*USER SPECIFIED(SUBAREA):

```

USER-SPECIFIED RUNOFF COEFFICIENT = .3500
S.C.S. CURVE NUMBER (AMC II) = 0
INITIAL SUBAREA FLOW-LENGTH(FEET) = 50.00
UPSTREAM ELEVATION(FEET) = 486.00
DOWNSTREAM ELEVATION(FEET) = 485.70
ELEVATION DIFFERENCE(FEET) = 0.30
SUBAREA OVERLAND TIME OF FLOW(MIN.) = 11.318
100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 4.978
SUBAREA RUNOFF(CFS) = 0.03
TOTAL AREA(ACRES) = 0.01 TOTAL RUNOFF(CFS) = 0.03

*****
FLOW PROCESS FROM NODE 108.00 TO NODE 107.00 IS CODE = 7
-----
>>>>>USER SPECIFIED HYDROLOGY INFORMATION AT NODE<<<<<
=====
USER-SPECIFIED VALUES ARE AS FOLLOWS:
TC(MIN) = 11.32 RAIN INTENSITY(INCH/HOUR) = 4.98
TOTAL AREA(ACRES) = 0.01 TOTAL RUNOFF(CFS) = 0.10

*****
FLOW PROCESS FROM NODE 107.00 TO NODE 106.00 IS CODE = 51
-----
>>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
>>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) = 485.70 DOWNSTREAM(FEET) = 485.00
CHANNEL LENGTH THRU SUBAREA(FEET) = 215.00 CHANNEL SLOPE = 0.0033
CHANNEL BASE(FEET) = 130.00 "Z" FACTOR = 2.000
MANNING'S FACTOR = 0.040 MAXIMUM DEPTH(FEET) = 1.00
100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 2.479
*USER SPECIFIED(SUBAREA):
USER-SPECIFIED RUNOFF COEFFICIENT = .4600
S.C.S. CURVE NUMBER (AMC II) = 0
TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) = 0.42
TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) = 0.16
AVERAGE FLOW DEPTH(FEET) = 0.02 TRAVEL TIME(MIN.) = 22.04
Tc(MIN.) = 33.36
SUBAREA AREA(ACRES) = 0.47 SUBAREA RUNOFF(CFS) = 0.54
AREA-AVERAGE RUNOFF COEFFICIENT = 0.487
TOTAL AREA(ACRES) = 0.5 PEAK FLOW RATE(CFS) = 0.59

END OF SUBAREA CHANNEL FLOW HYDRAULICS:
DEPTH(FEET) = 0.03 FLOW VELOCITY(FEET/SEC.) = 0.17
LONGEST FLOWPATH FROM NODE 108.00 TO NODE 106.00 = 265.00 FEET.

*****
FLOW PROCESS FROM NODE 106.00 TO NODE 105.00 IS CODE = 61
-----
>>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>(STANDARD CURB SECTION USED)<<<<<
=====
UPSTREAM ELEVATION(FEET) = 485.00 DOWNSTREAM ELEVATION(FEET) = 392.00
STREET LENGTH(FEET) = 1315.00 CURB HEIGHT(INCHES) = 6.0

```

STREET HALFWIDTH(FEET) = 16.00

DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) = 10.00

INSIDE STREET CROSSFALL(DECIMAL) = 0.020

OUTSIDE STREET CROSSFALL(DECIMAL) = 0.020

SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF = 1

STREET PARKWAY CROSSFALL(DECIMAL) = 0.050

Manning's FRICTION FACTOR for Streetflow Section(curbs-to-curbs) = 0.0130

Manning's FRICTION FACTOR for Back-of-Walk Flow Section = 0.0200

\*\*TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) = 2.89

STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:

STREET FLOW DEPTH(FEET) = 0.25

HALFSTREET FLOOD WIDTH(FEET) = 6.35

AVERAGE FLOW VELOCITY(FEET/SEC.) = 5.54

PRODUCT OF DEPTH&VELOCITY(FT\*FT/SEC.) = 1.40

STREET FLOW TRAVEL TIME(MIN.) = 3.95 Tc(MIN.) = 37.31

100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 2.306

\*USER SPECIFIED(SUBAREA):

USER-SPECIFIED RUNOFF COEFFICIENT = .6300

S.C.S. CURVE NUMBER (AMC II) = 0

AREA-AVERAGE RUNOFF COEFFICIENT = 0.611

SUBAREA AREA(ACRES) = 3.18 SUBAREA RUNOFF(CFS) = 4.62

TOTAL AREA(ACRES) = 3.7 PEAK FLOW RATE(CFS) = 5.16

END OF SUBAREA STREET FLOW HYDRAULICS:

DEPTH(FEET) = 0.29 HALFSTREET FLOOD WIDTH(FEET) = 8.38

FLOW VELOCITY(FEET/SEC.) = 6.29 DEPTH\*VELOCITY(FT\*FT/SEC.) = 1.85

LONGEST FLOWPATH FROM NODE 108.00 TO NODE 105.00 = 1580.00 FEET.

\*\*\*\*\*

FLOW PROCESS FROM NODE 106.00 TO NODE 105.00 IS CODE = 1

>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<

TOTAL NUMBER OF STREAMS = 2

CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 1 ARE:

TIME OF CONCENTRATION(MIN.) = 37.31

RAINFALL INTENSITY(INCH/HR) = 2.31

TOTAL STREAM AREA(ACRES) = 3.66

PEAK FLOW RATE(CFS) AT CONFLUENCE = 5.16

\*\*\*\*\*

FLOW PROCESS FROM NODE 122.00 TO NODE 121.00 IS CODE = 21

>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<

\*USER SPECIFIED(SUBAREA):

USER-SPECIFIED RUNOFF COEFFICIENT = .5800

S.C.S. CURVE NUMBER (AMC II) = 0

INITIAL SUBAREA FLOW-LENGTH(FEET) = 100.00

UPSTREAM ELEVATION(FEET) = 465.00

DOWNSTREAM ELEVATION(FEET) = 457.00

```

ELEVATION DIFFERENCE(FEET) =      8.00
SUBAREA OVERLAND TIME OF FLOW(MIN.) =      4.680
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =      8.431
NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
SUBAREA RUNOFF(CFS) =      0.41
TOTAL AREA(ACRES) =      0.08    TOTAL RUNOFF(CFS) =      0.41

*****
FLOW PROCESS FROM NODE      121.00 TO NODE      120.00 IS CODE =   61
-----
>>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>(STANDARD CURB SECTION USED)<<<<<
=====
UPSTREAM ELEVATION(FEET) =  457.00  DOWNSTREAM ELEVATION(FEET) =  392.00
STREET LENGTH(FEET) =    700.00    CURB HEIGHT(INCHES) =    6.0
STREET HALFWIDTH(FEET) =    16.00

DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =    10.00
INSIDE STREET CROSSFALL(DECIMAL) =    0.020
OUTSIDE STREET CROSSFALL(DECIMAL) =    0.020

SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =    1
STREET PARKWAY CROSSFALL(DECIMAL) =    0.050
Manning's FRICTION FACTOR for Streetflow Section(curbs-to-curbs) =    0.0130
Manning's FRICTION FACTOR for Back-of-Walk Flow Section =    0.0200

  **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      1.93
  STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
  STREET FLOW DEPTH(FEET) =    0.22
  HALFSTREET FLOOD WIDTH(FEET) =    4.63
  AVERAGE FLOW VELOCITY(FEET/SEC.) =    5.81
  PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.27
  STREET FLOW TRAVEL TIME(MIN.) =    2.01    Tc(MIN.) =    6.69
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =    6.990
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .5100
  S.C.S. CURVE NUMBER (AMC II) =    0
  AREA-AVERAGE RUNOFF COEFFICIENT =    0.516
  SUBAREA AREA(ACRES) =    0.85    SUBAREA RUNOFF(CFS) =    3.03
  TOTAL AREA(ACRES) =    0.9    PEAK FLOW RATE(CFS) =    3.37

END OF SUBAREA STREET FLOW HYDRAULICS:
DEPTH(FEET) = 0.25    HALFSTREET FLOOD WIDTH(FEET) =    6.35
FLOW VELOCITY(FEET/SEC.) =    6.45    DEPTH*VELOCITY(FT*FT/SEC.) =    1.63
LONGEST FLOWPATH FROM NODE      122.00 TO NODE      120.00 =    800.00 FEET.

*****
FLOW PROCESS FROM NODE      120.00 TO NODE      105.00 IS CODE =   31
-----
>>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) =    389.70  DOWNSTREAM(FEET) =    389.00
FLOW LENGTH(FEET) =    37.00    MANNING'S N =    0.011

```

DEPTH OF FLOW IN 12.0 INCH PIPE IS 6.7 INCHES  
 PIPE-FLOW VELOCITY(FEET/SEC.) = 7.51  
 ESTIMATED PIPE DIAMETER(INCH) = 12.00 NUMBER OF PIPES = 1  
 PIPE-FLOW(CFS) = 3.37  
 PIPE TRAVEL TIME(MIN.) = 0.08 Tc(MIN.) = 6.77  
 LONGEST FLOWPATH FROM NODE 122.00 TO NODE 105.00 = 837.00 FEET.

\*\*\*\*\*

FLOW PROCESS FROM NODE 120.00 TO NODE 105.00 IS CODE = 1

>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<  
 >>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<

=====

TOTAL NUMBER OF STREAMS = 2  
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 2 ARE:  
 TIME OF CONCENTRATION(MIN.) = 6.77  
 RAINFALL INTENSITY(INCH/HR) = 6.93  
 TOTAL STREAM AREA(ACRES) = 0.93  
 PEAK FLOW RATE(CFS) AT CONFLUENCE = 3.37

\*\* CONFLUENCE DATA \*\*

STREAM NUMBER	RUNOFF (CFS)	Tc (MIN.)	INTENSITY (INCH/HOUR)	AREA (ACRE)
1	5.16	37.31	2.306	3.66
2	3.37	6.77	6.935	0.93

RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO  
 CONFLUENCE FORMULA USED FOR 2 STREAMS.

\*\* PEAK FLOW RATE TABLE \*\*

STREAM NUMBER	RUNOFF (CFS)	Tc (MIN.)	INTENSITY (INCH/HOUR)
1	4.30	6.77	6.935
2	6.28	37.31	2.306

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:

PEAK FLOW RATE(CFS) = 6.28 Tc(MIN.) = 37.31  
 TOTAL AREA(ACRES) = 4.6  
 LONGEST FLOWPATH FROM NODE 108.00 TO NODE 105.00 = 1580.00 FEET.

\*\*\*\*\*

FLOW PROCESS FROM NODE 105.00 TO NODE 104.00 IS CODE = 31

>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<  
 >>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

=====

ELEVATION DATA: UPSTREAM(FEET) = 389.00 DOWNSTREAM(FEET) = 376.00  
 FLOW LENGTH(FEET) = 190.00 MANNING'S N = 0.011  
 DEPTH OF FLOW IN 12.0 INCH PIPE IS 6.6 INCHES  
 PIPE-FLOW VELOCITY(FEET/SEC.) = 14.20  
 ESTIMATED PIPE DIAMETER(INCH) = 12.00 NUMBER OF PIPES = 1  
 PIPE-FLOW(CFS) = 6.28  
 PIPE TRAVEL TIME(MIN.) = 0.22 Tc(MIN.) = 37.54  
 LONGEST FLOWPATH FROM NODE 108.00 TO NODE 104.00 = 1770.00 FEET.

```

*****
FLOW PROCESS FROM NODE      104.10 TO NODE      104.00 IS CODE =  81
-----
>>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
=====
100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.297
*USER SPECIFIED(SUBAREA):
USER-SPECIFIED RUNOFF COEFFICIENT = .3500
S.C.S. CURVE NUMBER (AMC II) =  0
AREA-AVERAGE RUNOFF COEFFICIENT = 0.5867
SUBAREA AREA(ACRES) =  0.10  SUBAREA RUNOFF(CFS) =  0.08
TOTAL AREA(ACRES) =  4.7  TOTAL RUNOFF(CFS) =  6.33
TC(MIN.) =  37.54

*****
FLOW PROCESS FROM NODE      104.00 TO NODE      103.00 IS CODE =  31
-----
>>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) =  374.30  DOWNSTREAM(FEET) =  374.10
FLOW LENGTH(FEET) =  35.00  MANNING'S N =  0.011
DEPTH OF FLOW IN  18.0 INCH PIPE IS  11.0 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) =  5.59
ESTIMATED PIPE DIAMETER(INCH) =  18.00  NUMBER OF PIPES =  1
PIPE-FLOW(CFS) =  6.33
PIPE TRAVEL TIME(MIN.) =  0.10  Tc(MIN.) =  37.64
LONGEST FLOWPATH FROM NODE  108.00 TO NODE  103.00 =  1805.00 FEET.

*****
FLOW PROCESS FROM NODE      103.00 TO NODE      102.00 IS CODE =  51
-----
>>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
>>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) =  374.10  DOWNSTREAM(FEET) =  374.00
CHANNEL LENGTH THRU SUBAREA(FEET) =  70.00  CHANNEL SLOPE =  0.0014
CHANNEL BASE(FEET) =  110.00  "Z" FACTOR =  2.000
MANNING'S FACTOR = 0.040  MAXIMUM DEPTH(FEET) =  1.00
CHANNEL FLOW THRU SUBAREA(CFS) =  6.33
FLOW VELOCITY(FEET/SEC.) =  0.39  FLOW DEPTH(FEET) =  0.15
TRAVEL TIME(MIN.) =  3.00  Tc(MIN.) =  40.64
LONGEST FLOWPATH FROM NODE  108.00 TO NODE  102.00 =  1875.00 FEET.

*****
FLOW PROCESS FROM NODE      103.00 TO NODE      102.00 IS CODE =  1
-----
>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
=====
TOTAL NUMBER OF STREAMS =  2
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
TIME OF CONCENTRATION(MIN.) =  40.64
RAINFALL INTENSITY(INCH/HR) =  2.18

```

TOTAL STREAM AREA(ACRES) = 4.70  
PEAK FLOW RATE(CFS) AT CONFLUENCE = 6.33

\*\*\*\*\*  
FLOW PROCESS FROM NODE 133.00 TO NODE 132.00 IS CODE = 21  
-----

>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<  
=====

\*USER SPECIFIED(SUBAREA):  
USER-SPECIFIED RUNOFF COEFFICIENT = .3500  
S.C.S. CURVE NUMBER (AMC II) = 0  
INITIAL SUBAREA FLOW-LENGTH(FEET) = 50.00  
UPSTREAM ELEVATION(FEET) = 450.00  
DOWNSTREAM ELEVATION(FEET) = 449.70  
ELEVATION DIFFERENCE(FEET) = 0.30  
SUBAREA OVERLAND TIME OF FLOW(MIN.) = 11.318  
100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 4.978  
SUBAREA RUNOFF(CFS) = 0.04  
TOTAL AREA(ACRES) = 0.02 TOTAL RUNOFF(CFS) = 0.04

\*\*\*\*\*  
FLOW PROCESS FROM NODE 133.00 TO NODE 132.00 IS CODE = 7  
-----

>>>>USER SPECIFIED HYDROLOGY INFORMATION AT NODE<<<<  
=====

USER-SPECIFIED VALUES ARE AS FOLLOWS:  
TC(MIN) = 11.32 RAIN INTENSITY(INCH/HOUR) = 4.98  
TOTAL AREA(ACRES) = 0.02 TOTAL RUNOFF(CFS) = 0.10

\*\*\*\*\*  
FLOW PROCESS FROM NODE 132.00 TO NODE 131.00 IS CODE = 51  
-----

>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<  
>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<  
=====

ELEVATION DATA: UPSTREAM(FEET) = 449.70 DOWNSTREAM(FEET) = 448.70  
CHANNEL LENGTH THRU SUBAREA(FEET) = 200.00 CHANNEL SLOPE = 0.0050  
CHANNEL BASE(FEET) = 100.00 "Z" FACTOR = 2.000  
MANNING'S FACTOR = 0.040 MAXIMUM DEPTH(FEET) = 1.00  
100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 2.896

\*USER SPECIFIED(SUBAREA):  
USER-SPECIFIED RUNOFF COEFFICIENT = .4600  
S.C.S. CURVE NUMBER (AMC II) = 0  
TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) = 0.45  
TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) = 0.22  
AVERAGE FLOW DEPTH(FEET) = 0.02 TRAVEL TIME(MIN.) = 14.90  
Tc(MIN.) = 26.22  
SUBAREA AREA(ACRES) = 0.47 SUBAREA RUNOFF(CFS) = 0.63  
AREA-AVERAGE RUNOFF COEFFICIENT = 0.478  
TOTAL AREA(ACRES) = 0.5 PEAK FLOW RATE(CFS) = 0.68

END OF SUBAREA CHANNEL FLOW HYDRAULICS:  
DEPTH(FEET) = 0.03 FLOW VELOCITY(FEET/SEC.) = 0.25  
LONGEST FLOWPATH FROM NODE 133.00 TO NODE 131.00 = 250.00 FEET.



\*\*\*\*\*  
FLOW PROCESS FROM NODE 131.00 TO NODE 130.10 IS CODE = 51  
-----

>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<  
>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<  
=====

ELEVATION DATA: UPSTREAM(FEET) = 448.70 DOWNSTREAM(FEET) = 385.00  
CHANNEL LENGTH THRU SUBAREA(FEET) = 305.00 CHANNEL SLOPE = 0.2089  
CHANNEL BASE(FEET) = 0.00 "Z" FACTOR = 2.000  
MANNING'S FACTOR = 0.015 MAXIMUM DEPTH(FEET) = 1.00  
100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 2.866  
\*USER SPECIFIED(SUBAREA):  
USER-SPECIFIED RUNOFF COEFFICIENT = .4400  
S.C.S. CURVE NUMBER (AMC II) = 0  
TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) = 2.18  
TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) = 11.92  
AVERAGE FLOW DEPTH(FEET) = 0.30 TRAVEL TIME(MIN.) = 0.43  
Tc(MIN.) = 26.64  
SUBAREA AREA(ACRES) = 2.37 SUBAREA RUNOFF(CFS) = 2.99  
AREA-AVERAGE RUNOFF COEFFICIENT = 0.447  
TOTAL AREA(ACRES) = 2.9 PEAK FLOW RATE(CFS) = 3.67

END OF SUBAREA CHANNEL FLOW HYDRAULICS:  
DEPTH(FEET) = 0.37 FLOW VELOCITY(FEET/SEC.) = 13.45  
LONGEST FLOWPATH FROM NODE 133.00 TO NODE 130.10 = 555.00 FEET.

\*\*\*\*\*  
FLOW PROCESS FROM NODE 130.10 TO NODE 130.00 IS CODE = 51  
-----

>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<  
>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<  
=====

ELEVATION DATA: UPSTREAM(FEET) = 385.00 DOWNSTREAM(FEET) = 374.10  
CHANNEL LENGTH THRU SUBAREA(FEET) = 226.00 CHANNEL SLOPE = 0.0482  
CHANNEL BASE(FEET) = 0.00 "Z" FACTOR = 2.000  
MANNING'S FACTOR = 0.015 MAXIMUM DEPTH(FEET) = 1.00  
CHANNEL FLOW THRU SUBAREA(CFS) = 3.67  
FLOW VELOCITY(FEET/SEC.) = 7.84 FLOW DEPTH(FEET) = 0.48  
TRAVEL TIME(MIN.) = 0.48 Tc(MIN.) = 27.13  
LONGEST FLOWPATH FROM NODE 133.00 TO NODE 130.00 = 781.00 FEET.

\*\*\*\*\*  
FLOW PROCESS FROM NODE 130.00 TO NODE 102.00 IS CODE = 51  
-----

>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<  
>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<  
=====

ELEVATION DATA: UPSTREAM(FEET) = 374.10 DOWNSTREAM(FEET) = 374.00  
CHANNEL LENGTH THRU SUBAREA(FEET) = 110.00 CHANNEL SLOPE = 0.0009  
CHANNEL BASE(FEET) = 110.00 "Z" FACTOR = 2.000  
MANNING'S FACTOR = 0.040 MAXIMUM DEPTH(FEET) = 1.00  
100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 2.468  
\*USER SPECIFIED(SUBAREA):

USER-SPECIFIED RUNOFF COEFFICIENT = .4000  
 S.C.S. CURVE NUMBER (AMC II) = 0  
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) = 4.15  
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) = 0.28  
 AVERAGE FLOW DEPTH(FEET) = 0.13 TRAVEL TIME(MIN.) = 6.46  
 Tc(MIN.) = 33.58  
 SUBAREA AREA(ACRES) = 0.98 SUBAREA RUNOFF(CFS) = 0.97  
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.435  
 TOTAL AREA(ACRES) = 3.8 PEAK FLOW RATE(CFS) = 4.12

END OF SUBAREA CHANNEL FLOW HYDRAULICS:  
 DEPTH(FEET) = 0.13 FLOW VELOCITY(FEET/SEC.) = 0.28  
 LONGEST FLOWPATH FROM NODE 133.00 TO NODE 102.00 = 891.00 FEET.

\*\*\*\*\*  
 FLOW PROCESS FROM NODE 130.00 TO NODE 102.00 IS CODE = 1

>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<  
 >>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<

=====  
 TOTAL NUMBER OF STREAMS = 2  
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 2 ARE:  
 TIME OF CONCENTRATION(MIN.) = 33.58  
 RAINFALL INTENSITY(INCH/HR) = 2.47  
 TOTAL STREAM AREA(ACRES) = 3.84  
 PEAK FLOW RATE(CFS) AT CONFLUENCE = 4.12

\*\* CONFLUENCE DATA \*\*

STREAM NUMBER	RUNOFF (CFS)	Tc (MIN.)	INTENSITY (INCH/HOUR)	AREA (ACRE)
1	6.33	40.64	2.182	4.70
2	4.12	33.58	2.468	3.84

RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO  
 CONFLUENCE FORMULA USED FOR 2 STREAMS.

\*\* PEAK FLOW RATE TABLE \*\*

STREAM NUMBER	RUNOFF (CFS)	Tc (MIN.)	INTENSITY (INCH/HOUR)
1	9.72	33.58	2.468
2	9.98	40.64	2.182

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:  
 PEAK FLOW RATE(CFS) = 9.98 Tc(MIN.) = 40.64  
 TOTAL AREA(ACRES) = 8.5  
 LONGEST FLOWPATH FROM NODE 108.00 TO NODE 102.00 = 1875.00 FEET.

\*\*\*\*\*  
 FLOW PROCESS FROM NODE 102.00 TO NODE 101.00 IS CODE = 31

>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<  
 >>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

=====  
 ELEVATION DATA: UPSTREAM(FEET) = 371.00 DOWNSTREAM(FEET) = 357.80

```

FLOW LENGTH(FEET) = 150.00 MANNING'S N = 0.011
DEPTH OF FLOW IN 12.0 INCH PIPE IS 8.3 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) = 17.30
ESTIMATED PIPE DIAMETER(INCH) = 12.00 NUMBER OF PIPES = 1
PIPE-FLOW(CFS) = 9.98
PIPE TRAVEL TIME(MIN.) = 0.14 Tc(MIN.) = 40.79
LONGEST FLOWPATH FROM NODE 108.00 TO NODE 101.00 = 2025.00 FEET.

*****
FLOW PROCESS FROM NODE 102.00 TO NODE 101.00 IS CODE = 1
-----
>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<
=====
TOTAL NUMBER OF STREAMS = 2
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 1 ARE:
TIME OF CONCENTRATION(MIN.) = 40.79
RAINFALL INTENSITY(INCH/HR) = 2.18
TOTAL STREAM AREA(ACRES) = 8.54
PEAK FLOW RATE(CFS) AT CONFLUENCE = 9.98

*****
FLOW PROCESS FROM NODE 152.00 TO NODE 151.00 IS CODE = 21
-----
>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<
=====
*USER SPECIFIED(SUBAREA):
USER-SPECIFIED RUNOFF COEFFICIENT = .3500
S.C.S. CURVE NUMBER (AMC II) = 0
INITIAL SUBAREA FLOW-LENGTH(FEET) = 100.00
UPSTREAM ELEVATION(FEET) = 517.20
DOWNSTREAM ELEVATION(FEET) = 502.00
ELEVATION DIFFERENCE(FEET) = 15.20
SUBAREA OVERLAND TIME OF FLOW(MIN.) = 6.267
WARNING: THE MAXIMUM OVERLAND FLOW SLOPE, 10.%, IS USED IN Tc CALCULATION!
100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 7.288
SUBAREA RUNOFF(CFS) = 0.20
TOTAL AREA(ACRES) = 0.08 TOTAL RUNOFF(CFS) = 0.20

*****
FLOW PROCESS FROM NODE 151.00 TO NODE 150.00 IS CODE = 51
-----
>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<
>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) = 502.00 DOWNSTREAM(FEET) = 375.00
CHANNEL LENGTH THRU SUBAREA(FEET) = 1249.00 CHANNEL SLOPE = 0.1017
CHANNEL BASE(FEET) = 10.00 "Z" FACTOR = 10.000
MANNING'S FACTOR = 0.040 MAXIMUM DEPTH(FEET) = 1.00
100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 4.377
*USER SPECIFIED(SUBAREA):
USER-SPECIFIED RUNOFF COEFFICIENT = .4400
S.C.S. CURVE NUMBER (AMC II) = 0
TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) = 4.14
TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) = 2.76

```

AVERAGE FLOW DEPTH( FEET ) = 0.13 TRAVEL TIME( MIN. ) = 7.55  
 Tc( MIN. ) = 13.82  
 SUBAREA AREA( ACRES ) = 3.95 SUBAREA RUNOFF( CFS ) = 7.61  
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.438  
 TOTAL AREA( ACRES ) = 4.0 PEAK FLOW RATE( CFS ) = 7.73

END OF SUBAREA CHANNEL FLOW HYDRAULICS:

DEPTH( FEET ) = 0.19 FLOW VELOCITY( FEET/SEC. ) = 3.50  
 LONGEST FLOWPATH FROM NODE 152.00 TO NODE 150.00 = 1349.00 FEET.

\*\*\*\*\*  
 FLOW PROCESS FROM NODE 150.00 TO NODE 101.00 IS CODE = 51

>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<  
 >>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<

ELEVATION DATA: UPSTREAM( FEET ) = 375.00 DOWNSTREAM( FEET ) = 357.80  
 CHANNEL LENGTH THRU SUBAREA( FEET ) = 1298.00 CHANNEL SLOPE = 0.0133  
 CHANNEL BASE( FEET ) = 2.00 "Z" FACTOR = 2.000  
 MANNING'S FACTOR = 0.040 MAXIMUM DEPTH( FEET ) = 2.00  
 100 YEAR RAINFALL INTENSITY( INCH/HOUR ) = 3.453

\*USER SPECIFIED( SUBAREA ):

USER-SPECIFIED RUNOFF COEFFICIENT = .4000  
 S.C.S. CURVE NUMBER (AMC II) = 0  
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW( CFS ) = 20.11  
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY( FEET/SEC. ) = 3.52  
 AVERAGE FLOW DEPTH( FEET ) = 1.26 TRAVEL TIME( MIN. ) = 6.14  
 Tc( MIN. ) = 19.95  
 SUBAREA AREA( ACRES ) = 17.75 SUBAREA RUNOFF( CFS ) = 24.52  
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.407  
 TOTAL AREA( ACRES ) = 21.8 PEAK FLOW RATE( CFS ) = 30.61

END OF SUBAREA CHANNEL FLOW HYDRAULICS:

DEPTH( FEET ) = 1.54 FLOW VELOCITY( FEET/SEC. ) = 3.92  
 LONGEST FLOWPATH FROM NODE 152.00 TO NODE 101.00 = 2647.00 FEET.

\*\*\*\*\*  
 FLOW PROCESS FROM NODE 150.00 TO NODE 101.00 IS CODE = 1

>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<  
 >>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<

TOTAL NUMBER OF STREAMS = 2  
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 2 ARE:  
 TIME OF CONCENTRATION( MIN. ) = 19.95  
 RAINFALL INTENSITY( INCH/HR ) = 3.45  
 TOTAL STREAM AREA( ACRES ) = 21.78  
 PEAK FLOW RATE( CFS ) AT CONFLUENCE = 30.61

\*\* CONFLUENCE DATA \*\*

STREAM NUMBER	RUNOFF (CFS)	Tc (MIN.)	INTENSITY (INCH/HOUR)	AREA (ACRE)
1	9.98	40.79	2.177	8.54
2	30.61	19.95	3.453	21.78

RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO  
CONFLUENCE FORMULA USED FOR 2 STREAMS.

\*\* PEAK FLOW RATE TABLE \*\*

STREAM NUMBER	RUNOFF (CFS)	Tc (MIN.)	INTENSITY (INCH/HOUR)
1	36.91	19.95	3.453
2	29.28	40.79	2.177

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:

PEAK FLOW RATE(CFS) = 36.91 Tc(MIN.) = 19.95  
TOTAL AREA(ACRES) = 30.3  
LONGEST FLOWPATH FROM NODE 152.00 TO NODE 101.00 = 2647.00 FEET.

\*\*\*\*\*  
FLOW PROCESS FROM NODE 101.00 TO NODE 100.00 IS CODE = 31

>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<  
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

=====

ELEVATION DATA: UPSTREAM(FEET) = 357.80 DOWNSTREAM(FEET) = 357.60  
FLOW LENGTH(FEET) = 10.00 MANNING'S N = 0.013  
DEPTH OF FLOW IN 27.0 INCH PIPE IS 19.4 INCHES  
PIPE-FLOW VELOCITY(FEET/SEC.) = 12.08  
ESTIMATED PIPE DIAMETER(INCH) = 27.00 NUMBER OF PIPES = 1  
PIPE-FLOW(CFS) = 36.91  
PIPE TRAVEL TIME(MIN.) = 0.01 Tc(MIN.) = 19.97  
LONGEST FLOWPATH FROM NODE 152.00 TO NODE 100.00 = 2657.00 FEET.

\*\*\*\*\*  
FLOW PROCESS FROM NODE 205.00 TO NODE 204.00 IS CODE = 21

>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<

=====

\*USER SPECIFIED(SUBAREA):  
USER-SPECIFIED RUNOFF COEFFICIENT = .3500  
S.C.S. CURVE NUMBER (AMC II) = 0  
INITIAL SUBAREA FLOW-LENGTH(FEET) = 100.00  
UPSTREAM ELEVATION(FEET) = 526.50  
DOWNSTREAM ELEVATION(FEET) = 523.00  
ELEVATION DIFFERENCE(FEET) = 3.50  
SUBAREA OVERLAND TIME OF FLOW(MIN.) = 8.892  
100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 5.816  
SUBAREA RUNOFF(CFS) = 0.47  
TOTAL AREA(ACRES) = 0.23 TOTAL RUNOFF(CFS) = 0.47

\*\*\*\*\*  
FLOW PROCESS FROM NODE 204.00 TO NODE 203.00 IS CODE = 51

>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<  
>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<

=====

ELEVATION DATA: UPSTREAM(FEET) = 523.00 DOWNSTREAM(FEET) = 430.90

```

CHANNEL LENGTH THRU SUBAREA(FEET) = 1356.00  CHANNEL SLOPE = 0.0679
CHANNEL BASE(FEET) = 10.00  "Z" FACTOR = 5.000
MANNING'S FACTOR = 0.040  MAXIMUM DEPTH(FEET) = 5.00
100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 4.136
*USER SPECIFIED(SUBAREA):
USER-SPECIFIED RUNOFF COEFFICIENT = .3500
S.C.S. CURVE NUMBER (AMC II) = 0
TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) = 10.56
TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) = 3.65
AVERAGE FLOW DEPTH(FEET) = 0.26  TRAVEL TIME(MIN.) = 6.19
Tc(MIN.) = 15.08
SUBAREA AREA(ACRES) = 13.60  SUBAREA RUNOFF(CFS) = 19.69
AREA-AVERAGE RUNOFF COEFFICIENT = 0.350
TOTAL AREA(ACRES) = 13.8  PEAK FLOW RATE(CFS) = 20.02

END OF SUBAREA CHANNEL FLOW HYDRAULICS:
DEPTH(FEET) = 0.37  FLOW VELOCITY(FEET/SEC.) = 4.55
LONGEST FLOWPATH FROM NODE 205.00 TO NODE 203.00 = 1456.00 FEET.

*****
FLOW PROCESS FROM NODE 204.00 TO NODE 203.00 IS CODE = 1
-----
>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<
=====
TOTAL NUMBER OF STREAMS = 2
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 1 ARE:
TIME OF CONCENTRATION(MIN.) = 15.08
RAINFALL INTENSITY(INCH/HR) = 4.14
TOTAL STREAM AREA(ACRES) = 13.83
PEAK FLOW RATE(CFS) AT CONFLUENCE = 20.02

*****
FLOW PROCESS FROM NODE 203.20 TO NODE 203.20 IS CODE = 7
-----
>>>>USER SPECIFIED HYDROLOGY INFORMATION AT NODE<<<<
=====
USER-SPECIFIED VALUES ARE AS FOLLOWS:
TC(MIN) = 18.12  RAIN INTENSITY(INCH/HOUR) = 3.67
TOTAL AREA(ACRES) = 16.20  TOTAL RUNOFF(CFS) = 24.26

*****
FLOW PROCESS FROM NODE 203.10 TO NODE 203.10 IS CODE = 51
-----
>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<
>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) = 455.00  DOWNSTREAM(FEET) = 430.90
CHANNEL LENGTH THRU SUBAREA(FEET) = 98.00  CHANNEL SLOPE = 0.2459
CHANNEL BASE(FEET) = 10.00  "Z" FACTOR = 5.000
MANNING'S FACTOR = 0.040  MAXIMUM DEPTH(FEET) = 5.00
100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 3.646
*USER SPECIFIED(SUBAREA):
USER-SPECIFIED RUNOFF COEFFICIENT = .3500
S.C.S. CURVE NUMBER (AMC II) = 0

```

TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) = 25.29  
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) = 7.48  
 AVERAGE FLOW DEPTH(FEET) = 0.29 TRAVEL TIME(MIN.) = 0.22  
 Tc(MIN.) = 18.34  
 SUBAREA AREA(ACRES) = 1.62 SUBAREA RUNOFF(CFS) = 2.07  
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.402  
 TOTAL AREA(ACRES) = 17.8 PEAK FLOW RATE(CFS) = 26.14

END OF SUBAREA CHANNEL FLOW HYDRAULICS:  
 DEPTH(FEET) = 0.30 FLOW VELOCITY(FEET/SEC.) = 7.57  
 LONGEST FLOWPATH FROM NODE 152.00 TO NODE 203.10 = 2745.00 FEET.

\*\*\*\*\*

FLOW PROCESS FROM NODE 203.10 TO NODE 203.00 IS CODE = 1

>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<  
 >>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<

=====

TOTAL NUMBER OF STREAMS = 2  
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 2 ARE:  
 TIME OF CONCENTRATION(MIN.) = 18.34  
 RAINFALL INTENSITY(INCH/HR) = 3.65  
 TOTAL STREAM AREA(ACRES) = 17.82  
 PEAK FLOW RATE(CFS) AT CONFLUENCE = 26.14

\*\* CONFLUENCE DATA \*\*

STREAM NUMBER	RUNOFF (CFS)	Tc (MIN.)	INTENSITY (INCH/HOUR)	AREA (ACRE)
1	20.02	15.08	4.136	13.83
2	26.14	18.34	3.646	17.82

RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO  
 CONFLUENCE FORMULA USED FOR 2 STREAMS.

\*\* PEAK FLOW RATE TABLE \*\*

STREAM NUMBER	RUNOFF (CFS)	Tc (MIN.)	INTENSITY (INCH/HOUR)
1	41.52	15.08	4.136
2	43.79	18.34	3.646

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:  
 PEAK FLOW RATE(CFS) = 43.79 Tc(MIN.) = 18.34  
 TOTAL AREA(ACRES) = 31.7  
 LONGEST FLOWPATH FROM NODE 152.00 TO NODE 203.00 = 2745.00 FEET.

\*\*\*\*\*

FLOW PROCESS FROM NODE 203.00 TO NODE 202.00 IS CODE = 51

>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<  
 >>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<

=====

ELEVATION DATA: UPSTREAM(FEET) = 430.90 DOWNSTREAM(FEET) = 419.00  
 CHANNEL LENGTH THRU SUBAREA(FEET) = 395.00 CHANNEL SLOPE = 0.0301  
 CHANNEL BASE(FEET) = 10.00 "Z" FACTOR = 5.000

MANNING'S FACTOR = 0.040    MAXIMUM DEPTH(FEET) =    5.00  
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) =    3.469  
 \*USER SPECIFIED(SUBAREA):  
 USER-SPECIFIED RUNOFF COEFFICIENT = .3500  
 S.C.S. CURVE NUMBER (AMC II) =    0  
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =        45.14  
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =    4.47  
 AVERAGE FLOW DEPTH(FEET) =    0.74    TRAVEL TIME(MIN.) =    1.47  
 Tc(MIN.) =    19.81  
 SUBAREA AREA(ACRES) =        2.23        SUBAREA RUNOFF(CFS) =        2.71  
 AREA-AVERAGE RUNOFF COEFFICIENT =    0.378  
 TOTAL AREA(ACRES) =        33.9        PEAK FLOW RATE(CFS) =        44.37

END OF SUBAREA CHANNEL FLOW HYDRAULICS:  
 DEPTH(FEET) = 0.73    FLOW VELOCITY(FEET/SEC.) =    4.46  
 LONGEST FLOWPATH FROM NODE    152.00 TO NODE    202.00 =    3140.00 FEET.

\*\*\*\*\*  
 FLOW PROCESS FROM NODE    203.00 TO NODE    202.00 IS CODE =    1

>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<

=====  
 TOTAL NUMBER OF STREAMS =    2  
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM    1 ARE:  
 TIME OF CONCENTRATION(MIN.) =    19.81  
 RAINFALL INTENSITY(INCH/HR) =    3.47  
 TOTAL STREAM AREA(ACRES) =        33.88  
 PEAK FLOW RATE(CFS) AT CONFLUENCE =        44.37

\*\*\*\*\*  
 FLOW PROCESS FROM NODE    202.10 TO NODE    202.10 IS CODE =    7

>>>>USER SPECIFIED HYDROLOGY INFORMATION AT NODE<<<<

=====  
 USER-SPECIFIED VALUES ARE AS FOLLOWS:  
 TC(MIN) = 19.49    RAIN INTENSITY(INCH/HOUR) =    3.51  
 TOTAL AREA(ACRES) =        2.40    TOTAL RUNOFF(CFS) =        4.03

\*\*\*\*\*  
 FLOW PROCESS FROM NODE    202.10 TO NODE    202.00 IS CODE =    51

>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<  
 >>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<

=====  
 ELEVATION DATA: UPSTREAM(FEET) =    445.00    DOWNSTREAM(FEET) =    419.00  
 CHANNEL LENGTH THRU SUBAREA(FEET) =    98.00    CHANNEL SLOPE =    0.2653  
 CHANNEL BASE(FEET) =    0.00    "Z" FACTOR =    2.000  
 MANNING'S FACTOR = 0.015    MAXIMUM DEPTH(FEET) =    1.00  
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) =    3.494  
 \*USER SPECIFIED(SUBAREA):  
 USER-SPECIFIED RUNOFF COEFFICIENT = .3500  
 S.C.S. CURVE NUMBER (AMC II) =    0  
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =        4.54  
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =    15.83



AVERAGE FLOW DEPTH( FEET ) = 0.38 TRAVEL TIME( MIN. ) = 0.10  
Tc( MIN. ) = 19.59  
SUBAREA AREA( ACRES ) = 0.83 SUBAREA RUNOFF( CFS ) = 1.01  
AREA-AVERAGE RUNOFF COEFFICIENT = 0.446  
TOTAL AREA( ACRES ) = 3.2 PEAK FLOW RATE( CFS ) = 5.03

END OF SUBAREA CHANNEL FLOW HYDRAULICS:

DEPTH( FEET ) = 0.39 FLOW VELOCITY( FEET/SEC. ) = 16.22  
LONGEST FLOWPATH FROM NODE 152.00 TO NODE 202.00 = 2843.00 FEET.

\*\*\*\*\*

FLOW PROCESS FROM NODE 202.10 TO NODE 202.00 IS CODE = 1

-----  
>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<  
>>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<

=====

TOTAL NUMBER OF STREAMS = 2  
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 2 ARE:  
TIME OF CONCENTRATION( MIN. ) = 19.59  
RAINFALL INTENSITY( INCH/HR ) = 3.49  
TOTAL STREAM AREA( ACRES ) = 3.23  
PEAK FLOW RATE( CFS ) AT CONFLUENCE = 5.03

\*\* CONFLUENCE DATA \*\*

STREAM NUMBER	RUNOFF (CFS)	Tc (MIN.)	INTENSITY (INCH/HOUR)	AREA (ACRE)
1	44.37	19.81	3.469	33.88
2	5.03	19.59	3.494	3.23

RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO  
CONFLUENCE FORMULA USED FOR 2 STREAMS.

\*\* PEAK FLOW RATE TABLE \*\*

STREAM NUMBER	RUNOFF (CFS)	Tc (MIN.)	INTENSITY (INCH/HOUR)
1	49.09	19.59	3.494
2	49.37	19.81	3.469

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:

PEAK FLOW RATE( CFS ) = 49.37 Tc( MIN. ) = 19.81  
TOTAL AREA( ACRES ) = 37.1  
LONGEST FLOWPATH FROM NODE 152.00 TO NODE 202.00 = 3140.00 FEET.

\*\*\*\*\*

FLOW PROCESS FROM NODE 202.00 TO NODE 201.00 IS CODE = 51

-----  
>>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<  
>>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<

=====

ELEVATION DATA: UPSTREAM( FEET ) = 419.00 DOWNSTREAM( FEET ) = 411.00  
CHANNEL LENGTH THRU SUBAREA( FEET ) = 458.00 CHANNEL SLOPE = 0.0175  
CHANNEL BASE( FEET ) = 40.00 "Z" FACTOR = 5.000  
MANNING'S FACTOR = 0.040 MAXIMUM DEPTH( FEET ) = 5.00  
100 YEAR RAINFALL INTENSITY( INCH/HOUR ) = 3.189

```

*USER SPECIFIED(SUBAREA):
USER-SPECIFIED RUNOFF COEFFICIENT = .3500
S.C.S. CURVE NUMBER (AMC II) = 0
TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) = 51.93
TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) = 2.76
AVERAGE FLOW DEPTH(FEET) = 0.45 TRAVEL TIME(MIN.) = 2.76
Tc(MIN.) = 22.57
SUBAREA AREA(ACRES) = 4.59 SUBAREA RUNOFF(CFS) = 5.12
AREA-AVERAGE RUNOFF COEFFICIENT = 0.380
TOTAL AREA(ACRES) = 41.7 PEAK FLOW RATE(CFS) = 50.50

END OF SUBAREA CHANNEL FLOW HYDRAULICS:
DEPTH(FEET) = 0.44 FLOW VELOCITY(FEET/SEC.) = 2.73
LONGEST FLOWPATH FROM NODE 152.00 TO NODE 201.00 = 3598.00 FEET.

*****
FLOW PROCESS FROM NODE 202.00 TO NODE 201.00 IS CODE = 1
-----
>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<
=====
TOTAL NUMBER OF STREAMS = 2
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 1 ARE:
TIME OF CONCENTRATION(MIN.) = 22.57
RAINFALL INTENSITY(INCH/HR) = 3.19
TOTAL STREAM AREA(ACRES) = 41.70
PEAK FLOW RATE(CFS) AT CONFLUENCE = 50.50

*****
FLOW PROCESS FROM NODE 258.00 TO NODE 257.00 IS CODE = 21
-----
>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<
=====
*USER SPECIFIED(SUBAREA):
USER-SPECIFIED RUNOFF COEFFICIENT = .3500
S.C.S. CURVE NUMBER (AMC II) = 0
INITIAL SUBAREA FLOW-LENGTH(FEET) = 50.00
UPSTREAM ELEVATION(FEET) = 491.00
DOWNSTREAM ELEVATION(FEET) = 490.70
ELEVATION DIFFERENCE(FEET) = 0.30
SUBAREA OVERLAND TIME OF FLOW(MIN.) = 11.318
100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 4.978
SUBAREA RUNOFF(CFS) = 0.05
TOTAL AREA(ACRES) = 0.03 TOTAL RUNOFF(CFS) = 0.05

*****
FLOW PROCESS FROM NODE 258.00 TO NODE 257.00 IS CODE = 7
-----
>>>>USER SPECIFIED HYDROLOGY INFORMATION AT NODE<<<<
=====
USER-SPECIFIED VALUES ARE AS FOLLOWS:
TC(MIN) = 11.32 RAIN INTENSITY(INCH/HOUR) = 4.98
TOTAL AREA(ACRES) = 0.03 TOTAL RUNOFF(CFS) = 0.10

*****

```

FLOW PROCESS FROM NODE 257.00 TO NODE 256.00 IS CODE = 51

>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<

>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<

ELEVATION DATA: UPSTREAM(FEET) = 490.70 DOWNSTREAM(FEET) = 482.00  
CHANNEL LENGTH THRU SUBAREA(FEET) = 565.00 CHANNEL SLOPE = 0.0154  
CHANNEL BASE(FEET) = 32.00 "Z" FACTOR = 2.000  
MANNING'S FACTOR = 0.040 MAXIMUM DEPTH(FEET) = 1.00  
100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 2.866

\*USER SPECIFIED(SUBAREA):

USER-SPECIFIED RUNOFF COEFFICIENT = .4300

S.C.S. CURVE NUMBER (AMC II) = 0

TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) = 0.85

TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) = 0.61

AVERAGE FLOW DEPTH(FEET) = 0.04 TRAVEL TIME(MIN.) = 15.32

Tc(MIN.) = 26.63

SUBAREA AREA(ACRES) = 1.10 SUBAREA RUNOFF(CFS) = 1.36

AREA-AVERAGE RUNOFF COEFFICIENT = 0.437

TOTAL AREA(ACRES) = 1.1 PEAK FLOW RATE(CFS) = 1.41

END OF SUBAREA CHANNEL FLOW HYDRAULICS:

DEPTH(FEET) = 0.06 FLOW VELOCITY(FEET/SEC.) = 0.69

LONGEST FLOWPATH FROM NODE 258.00 TO NODE 256.00 = 615.00 FEET.

\*\*\*\*\*

FLOW PROCESS FROM NODE 256.00 TO NODE 255.00 IS CODE = 61

>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<

>>>>(STANDARD CURB SECTION USED)<<<<

UPSTREAM ELEVATION(FEET) = 482.00 DOWNSTREAM ELEVATION(FEET) = 464.00  
STREET LENGTH(FEET) = 560.00 CURB HEIGHT(INCHES) = 6.0  
STREET HALFWIDTH(FEET) = 16.00

DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) = 10.00

INSIDE STREET CROSSFALL(DECIMAL) = 0.020

OUTSIDE STREET CROSSFALL(DECIMAL) = 0.020

SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF = 1

STREET PARKWAY CROSSFALL(DECIMAL) = 0.050

Manning's FRICTION FACTOR for Streetflow Section(curbs-to-curbs) = 0.0130

Manning's FRICTION FACTOR for Back-of-Walk Flow Section = 0.0200

\*\*TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) = 3.78

STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:

STREET FLOW DEPTH(FEET) = 0.30

HALFSTREET FLOOD WIDTH(FEET) = 8.70

AVERAGE FLOW VELOCITY(FEET/SEC.) = 4.32

PRODUCT OF DEPTH&VELOCITY(FT\*FT/SEC.) = 1.30

STREET FLOW TRAVEL TIME(MIN.) = 2.16 Tc(MIN.) = 28.79

100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 2.726

\*USER SPECIFIED(SUBAREA):

USER-SPECIFIED RUNOFF COEFFICIENT = .5000

S.C.S. CURVE NUMBER (AMC II) = 0  
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.485  
 SUBAREA AREA(ACRES) = 3.47 SUBAREA RUNOFF(CFS) = 4.73  
 TOTAL AREA(ACRES) = 4.6 PEAK FLOW RATE(CFS) = 6.07

END OF SUBAREA STREET FLOW HYDRAULICS:

DEPTH(FEET) = 0.34 HALFSTREET FLOOD WIDTH(FEET) = 10.73  
 FLOW VELOCITY(FEET/SEC.) = 4.79 DEPTH\*VELOCITY(FT\*FT/SEC.) = 1.63  
 LONGEST FLOWPATH FROM NODE 258.00 TO NODE 255.00 = 1175.00 FEET.

\*\*\*\*\*

FLOW PROCESS FROM NODE 255.00 TO NODE 254.00 IS CODE = 31

>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<

>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<

=====

ELEVATION DATA: UPSTREAM(FEET) = 461.00 DOWNSTREAM(FEET) = 456.00  
 FLOW LENGTH(FEET) = 260.00 MANNING'S N = 0.011  
 DEPTH OF FLOW IN 15.0 INCH PIPE IS 8.3 INCHES  
 PIPE-FLOW VELOCITY(FEET/SEC.) = 8.75  
 ESTIMATED PIPE DIAMETER(INCH) = 15.00 NUMBER OF PIPES = 1  
 PIPE-FLOW(CFS) = 6.07  
 PIPE TRAVEL TIME(MIN.) = 0.50 Tc(MIN.) = 29.29  
 LONGEST FLOWPATH FROM NODE 258.00 TO NODE 254.00 = 1435.00 FEET.

\*\*\*\*\*

FLOW PROCESS FROM NODE 254.00 TO NODE 253.00 IS CODE = 51

>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<

>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<

=====

ELEVATION DATA: UPSTREAM(FEET) = 456.00 DOWNSTREAM(FEET) = 434.00  
 CHANNEL LENGTH THRU SUBAREA(FEET) = 142.00 CHANNEL SLOPE = 0.1549  
 CHANNEL BASE(FEET) = 0.00 "Z" FACTOR = 2.000  
 MANNING'S FACTOR = 0.015 MAXIMUM DEPTH(FEET) = 1.00  
 CHANNEL FLOW THRU SUBAREA(CFS) = 6.07  
 FLOW VELOCITY(FEET/SEC.) = 13.74 FLOW DEPTH(FEET) = 0.47  
 TRAVEL TIME(MIN.) = 0.17 Tc(MIN.) = 29.46  
 LONGEST FLOWPATH FROM NODE 258.00 TO NODE 253.00 = 1577.00 FEET.

\*\*\*\*\*

FLOW PROCESS FROM NODE 253.00 TO NODE 252.10 IS CODE = 31

>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<

>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<

=====

ELEVATION DATA: UPSTREAM(FEET) = 530.60 DOWNSTREAM(FEET) = 515.76  
 FLOW LENGTH(FEET) = 14.30 MANNING'S N = 0.011  
 DEPTH OF FLOW IN 6.0 INCH PIPE IS 4.5 INCHES  
 PIPE-FLOW VELOCITY(FEET/SEC.) = 38.06  
 ESTIMATED PIPE DIAMETER(INCH) = 6.00 NUMBER OF PIPES = 1  
 PIPE-FLOW(CFS) = 6.07  
 PIPE TRAVEL TIME(MIN.) = 0.01 Tc(MIN.) = 29.47  
 LONGEST FLOWPATH FROM NODE 258.00 TO NODE 252.10 = 1591.30 FEET.

```

*****
FLOW PROCESS FROM NODE      252.10 TO NODE      252.00 IS CODE =  31
-----
>>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) =   515.76  DOWNSTREAM(FEET) =   515.60
FLOW LENGTH(FEET) =    13.00  MANNING'S N =  0.011
DEPTH OF FLOW IN  15.0 INCH PIPE IS   9.6 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) =   7.35
ESTIMATED PIPE DIAMETER(INCH) =  15.00  NUMBER OF PIPES =   1
PIPE-FLOW(CFS) =    6.07
PIPE TRAVEL TIME(MIN.) =   0.03  Tc(MIN.) =   29.50
LONGEST FLOWPATH FROM NODE      258.00 TO NODE      252.00 =   1604.30 FEET.

*****
FLOW PROCESS FROM NODE      252.00 TO NODE      251.00 IS CODE =  51
-----
>>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
>>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) =   415.60  DOWNSTREAM(FEET) =   415.00
CHANNEL LENGTH THRU SUBAREA(FEET) =   40.00  CHANNEL SLOPE =  0.0150
CHANNEL BASE(FEET) =   27.00  "Z" FACTOR =   2.000
MANNING'S FACTOR = 0.040  MAXIMUM DEPTH(FEET) =   1.00
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.655
*USER SPECIFIED(SUBAREA):
USER-SPECIFIED RUNOFF COEFFICIENT = .3500
S.C.S. CURVE NUMBER (AMC II) =   0
TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =    6.19
TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.37
AVERAGE FLOW DEPTH(FEET) =   0.16  TRAVEL TIME(MIN.) =   0.49
Tc(MIN.) =   29.98
SUBAREA AREA(ACRES) =   0.25  SUBAREA RUNOFF(CFS) =   0.23
AREA-AVERAGE RUNOFF COEFFICIENT =  0.478
TOTAL AREA(ACRES) =   4.8  PEAK FLOW RATE(CFS) =   6.15

END OF SUBAREA CHANNEL FLOW HYDRAULICS:
DEPTH(FEET) =  0.16  FLOW VELOCITY(FEET/SEC.) =   1.36
LONGEST FLOWPATH FROM NODE      258.00 TO NODE      251.00 =   1644.30 FEET.

*****
FLOW PROCESS FROM NODE      251.00 TO NODE      250.00 IS CODE =  31
-----
>>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) =   411.50  DOWNSTREAM(FEET) =   411.00
FLOW LENGTH(FEET) =   21.00  MANNING'S N =  0.011
DEPTH OF FLOW IN  12.0 INCH PIPE IS   9.5 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) =   9.18
ESTIMATED PIPE DIAMETER(INCH) =  12.00  NUMBER OF PIPES =   1
PIPE-FLOW(CFS) =    6.15

```

```

PIPE TRAVEL TIME(MIN.) = 0.04      Tc(MIN.) = 30.02
LONGEST FLOWPATH FROM NODE 258.00 TO NODE 250.00 = 1665.30 FEET.

*****
FLOW PROCESS FROM NODE 250.00 TO NODE 201.00 IS CODE = 1
-----
>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
>>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
=====
TOTAL NUMBER OF STREAMS = 2
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 2 ARE:
TIME OF CONCENTRATION(MIN.) = 30.02
RAINFALL INTENSITY(INCH/HR) = 2.65
TOTAL STREAM AREA(ACRES) = 4.85
PEAK FLOW RATE(CFS) AT CONFLUENCE = 6.15

** CONFLUENCE DATA **
STREAM      RUNOFF      Tc      INTENSITY      AREA
NUMBER      (CFS)      (MIN.)  (INCH/HR)      (ACRE)
1           50.50      22.57      3.189          41.70
2           6.15      30.02      2.653          4.85

RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
CONFLUENCE FORMULA USED FOR 2 STREAMS.

** PEAK FLOW RATE TABLE **
STREAM      RUNOFF      Tc      INTENSITY
NUMBER      (CFS)      (MIN.)  (INCH/HR)
1           55.13      22.57      3.189
2           48.17      30.02      2.653

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
PEAK FLOW RATE(CFS) = 55.13      Tc(MIN.) = 22.57
TOTAL AREA(ACRES) = 46.5
LONGEST FLOWPATH FROM NODE 152.00 TO NODE 201.00 = 3598.00 FEET.

*****
FLOW PROCESS FROM NODE 201.00 TO NODE 201.10 IS CODE = 41
-----
>>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) = 411.00 DOWNSTREAM(FEET) = 410.40
FLOW LENGTH(FEET) = 30.00 MANNING'S N = 0.013
DEPTH OF FLOW IN 27.0 INCH PIPE IS 15.8 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) = 11.41
GIVEN PIPE DIAMETER(INCH) = 27.00 NUMBER OF PIPES = 2
PIPE-FLOW(CFS) = 55.13
PIPE TRAVEL TIME(MIN.) = 0.04      Tc(MIN.) = 22.62
LONGEST FLOWPATH FROM NODE 152.00 TO NODE 201.10 = 3628.00 FEET.

*****
FLOW PROCESS FROM NODE 201.10 TO NODE 200.00 IS CODE = 51
-----

```

>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<  
>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<

```
=====
ELEVATION DATA: UPSTREAM(FEET) =    410.40  DOWNSTREAM(FEET) =    404.00
CHANNEL LENGTH THRU SUBAREA(FEET) =   320.00  CHANNEL SLOPE =   0.0200
CHANNEL BASE(FEET) =    30.00  "Z" FACTOR =    3.000
MANNING'S FACTOR = 0.040  MAXIMUM DEPTH(FEET) =    5.00
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =   3.049
*USER SPECIFIED(SUBAREA):
USER-SPECIFIED RUNOFF COEFFICIENT = .3500
S.C.S. CURVE NUMBER (AMC II) =    0
TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =    57.94
TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =    3.36
AVERAGE FLOW DEPTH(FEET) =    0.54  TRAVEL TIME(MIN.) =    1.59
Tc(MIN.) =   24.20
SUBAREA AREA(ACRES) =    5.27  SUBAREA RUNOFF(CFS) =    5.62
AREA-AVERAGE RUNOFF COEFFICIENT =   0.386
TOTAL AREA(ACRES) =    51.8  PEAK FLOW RATE(CFS) =    60.96
=====
```

```
END OF SUBAREA CHANNEL FLOW HYDRAULICS:
DEPTH(FEET) = 0.56  FLOW VELOCITY(FEET/SEC.) =    3.44
LONGEST FLOWPATH FROM NODE    152.00 TO NODE    200.00 =    3948.00 FEET.
=====
```

```
END OF STUDY SUMMARY:
TOTAL AREA(ACRES)      =    51.8  TC(MIN.) =    24.20
PEAK FLOW RATE(CFS)    =    60.96
=====
=====
```

END OF RATIONAL METHOD ANALYSIS

### C. PROPOSED DETAINED 100-YEAR HYDROLOGY



\*\*\*\*\*

RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE  
Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT  
2003,1985,1981 HYDROLOGY MANUAL  
(c) Copyright 1982-2012 Advanced Engineering Software (aes)  
Ver. 19.0 Release Date: 06/01/2012 License ID 1459

Analysis prepared by:

BHA Inc  
5115 Avenida Encinas, Suite L  
Carlsbad CA 92008

\*\*\*\*\* DESCRIPTION OF STUDY \*\*\*\*\*  
\* Proposed Detained Condition Hydrology Analysis \*  
\* 100 Year Storm Frequency \*  
\* \*  
\*\*\*\*\*

FILE NAME: 1049D100.DAT  
TIME/DATE OF STUDY: 13:47 01/22/2013

-----  
USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:  
-----

2003 SAN DIEGO MANUAL CRITERIA

USER SPECIFIED STORM EVENT(YEAR) = 100.00  
6-HOUR DURATION PRECIPITATION (INCHES) = 3.200  
SPECIFIED MINIMUM PIPE SIZE(INCH) = 3.00  
SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95  
SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD

NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS

\*USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL\*

NO.	HALF- WIDTH (FT)	CROWN TO CROSSFALL (FT)	STREET-CROSSFALL: IN- / OUT- / PARK- SIDE / SIDE / WAY	CURB HEIGHT (FT)	GUTTER-GEOMETRIES: WIDTH (FT)	LIP (FT)	HIKE (FT)	MANNING FACTOR (n)
1	30.0	20.0	0.018/0.018/0.020	0.67	2.00	0.0313	0.167	0.0150

GLOBAL STREET FLOW-DEPTH CONSTRAINTS:

1. Relative Flow-Depth = 0.00 FEET  
as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
2. (Depth)\*(Velocity) Constraint = 6.0 (FT\*FT/S)

\*SIZE PIPE WITH A FLOW CAPACITY GREATER THAN  
OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.\*

\*\*\*\*\*  
FLOW PROCESS FROM NODE 108.00 TO NODE 107.00 IS CODE = 21  
-----

>>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<

=====

\*USER SPECIFIED(SUBAREA):

```

USER-SPECIFIED RUNOFF COEFFICIENT = .3500
S.C.S. CURVE NUMBER (AMC II) = 0
INITIAL SUBAREA FLOW-LENGTH(FEET) = 50.00
UPSTREAM ELEVATION(FEET) = 486.00
DOWNSTREAM ELEVATION(FEET) = 485.70
ELEVATION DIFFERENCE(FEET) = 0.30
SUBAREA OVERLAND TIME OF FLOW(MIN.) = 11.318
100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 4.978
SUBAREA RUNOFF(CFS) = 0.03
TOTAL AREA(ACRES) = 0.01 TOTAL RUNOFF(CFS) = 0.03

*****
FLOW PROCESS FROM NODE 108.00 TO NODE 107.00 IS CODE = 7
-----
>>>>>USER SPECIFIED HYDROLOGY INFORMATION AT NODE<<<<<
=====
USER-SPECIFIED VALUES ARE AS FOLLOWS:
TC(MIN) = 11.32 RAIN INTENSITY(INCH/HOUR) = 4.98
TOTAL AREA(ACRES) = 0.01 TOTAL RUNOFF(CFS) = 0.10

*****
FLOW PROCESS FROM NODE 107.00 TO NODE 106.00 IS CODE = 51
-----
>>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
>>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) = 485.70 DOWNSTREAM(FEET) = 485.00
CHANNEL LENGTH THRU SUBAREA(FEET) = 215.00 CHANNEL SLOPE = 0.0033
CHANNEL BASE(FEET) = 130.00 "Z" FACTOR = 2.000
MANNING'S FACTOR = 0.040 MAXIMUM DEPTH(FEET) = 1.00
100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 2.479
*USER SPECIFIED(SUBAREA):
USER-SPECIFIED RUNOFF COEFFICIENT = .4600
S.C.S. CURVE NUMBER (AMC II) = 0
TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) = 0.42
TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) = 0.16
AVERAGE FLOW DEPTH(FEET) = 0.02 TRAVEL TIME(MIN.) = 22.04
Tc(MIN.) = 33.36
SUBAREA AREA(ACRES) = 0.47 SUBAREA RUNOFF(CFS) = 0.54
AREA-AVERAGE RUNOFF COEFFICIENT = 0.487
TOTAL AREA(ACRES) = 0.5 PEAK FLOW RATE(CFS) = 0.59

END OF SUBAREA CHANNEL FLOW HYDRAULICS:
DEPTH(FEET) = 0.03 FLOW VELOCITY(FEET/SEC.) = 0.17
LONGEST FLOWPATH FROM NODE 108.00 TO NODE 106.00 = 265.00 FEET.

*****
FLOW PROCESS FROM NODE 106.00 TO NODE 105.00 IS CODE = 61
-----
>>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>(STANDARD CURB SECTION USED)<<<<<
=====
UPSTREAM ELEVATION(FEET) = 485.00 DOWNSTREAM ELEVATION(FEET) = 392.00
STREET LENGTH(FEET) = 1315.00 CURB HEIGHT(INCHES) = 6.0

```

STREET HALFWIDTH( FEET) = 16.00

DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK( FEET) = 10.00

INSIDE STREET CROSSFALL( DECIMAL) = 0.020

OUTSIDE STREET CROSSFALL( DECIMAL) = 0.020

SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF = 1

STREET PARKWAY CROSSFALL( DECIMAL) = 0.050

Manning's FRICTION FACTOR for Streetflow Section( curb-to-curb) = 0.0130

Manning's FRICTION FACTOR for Back-of-Walk Flow Section = 0.0200

\*\*TRAVEL TIME COMPUTED USING ESTIMATED FLOW( CFS) = 2.89

STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:

STREET FLOW DEPTH( FEET) = 0.25

HALFSTREET FLOOD WIDTH( FEET) = 6.35

AVERAGE FLOW VELOCITY( FEET/SEC.) = 5.54

PRODUCT OF DEPTH&VELOCITY( FT\*FT/SEC.) = 1.40

STREET FLOW TRAVEL TIME( MIN.) = 3.95 Tc( MIN.) = 37.31

100 YEAR RAINFALL INTENSITY( INCH/HOUR) = 2.306

\*USER SPECIFIED( SUBAREA):

USER-SPECIFIED RUNOFF COEFFICIENT = .6300

S.C.S. CURVE NUMBER (AMC II) = 0

AREA-AVERAGE RUNOFF COEFFICIENT = 0.611

SUBAREA AREA( ACRES) = 3.18 SUBAREA RUNOFF( CFS) = 4.62

TOTAL AREA( ACRES) = 3.7 PEAK FLOW RATE( CFS) = 5.16

END OF SUBAREA STREET FLOW HYDRAULICS:

DEPTH( FEET) = 0.29 HALFSTREET FLOOD WIDTH( FEET) = 8.38

FLOW VELOCITY( FEET/SEC.) = 6.29 DEPTH\*VELOCITY( FT\*FT/SEC.) = 1.85

LONGEST FLOWPATH FROM NODE 108.00 TO NODE 105.00 = 1580.00 FEET.

\*\*\*\*\*

FLOW PROCESS FROM NODE 106.00 TO NODE 105.00 IS CODE = 1

>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<

TOTAL NUMBER OF STREAMS = 2

CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 1 ARE:

TIME OF CONCENTRATION( MIN.) = 37.31

RAINFALL INTENSITY( INCH/HR) = 2.31

TOTAL STREAM AREA( ACRES) = 3.66

PEAK FLOW RATE( CFS) AT CONFLUENCE = 5.16

\*\*\*\*\*

FLOW PROCESS FROM NODE 122.00 TO NODE 121.00 IS CODE = 21

>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<

\*USER SPECIFIED( SUBAREA):

USER-SPECIFIED RUNOFF COEFFICIENT = .5800

S.C.S. CURVE NUMBER (AMC II) = 0

INITIAL SUBAREA FLOW-LENGTH( FEET) = 100.00

UPSTREAM ELEVATION( FEET) = 465.00

DOWNSTREAM ELEVATION( FEET) = 457.00

```

ELEVATION DIFFERENCE(FEET) =      8.00
SUBAREA OVERLAND TIME OF FLOW(MIN.) =      4.680
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =      8.431
NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
SUBAREA RUNOFF(CFS) =      0.41
TOTAL AREA(ACRES) =      0.08    TOTAL RUNOFF(CFS) =      0.41

*****
FLOW PROCESS FROM NODE      121.00 TO NODE      120.00 IS CODE =   61
-----
>>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>(STANDARD CURB SECTION USED)<<<<<
=====
UPSTREAM ELEVATION(FEET) =  457.00  DOWNSTREAM ELEVATION(FEET) =  392.00
STREET LENGTH(FEET) =    700.00    CURB HEIGHT(INCHES) =    6.0
STREET HALFWIDTH(FEET) =    16.00

DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =    10.00
INSIDE STREET CROSSFALL(DECIMAL) =    0.020
OUTSIDE STREET CROSSFALL(DECIMAL) =    0.020

SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =    1
STREET PARKWAY CROSSFALL(DECIMAL) =    0.050
Manning's FRICTION FACTOR for Streetflow Section(curbs-to-curbs) =    0.0130
Manning's FRICTION FACTOR for Back-of-Walk Flow Section =    0.0200

  **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      1.93
  STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
  STREET FLOW DEPTH(FEET) =    0.22
  HALFSTREET FLOOD WIDTH(FEET) =    4.63
  AVERAGE FLOW VELOCITY(FEET/SEC.) =    5.81
  PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.27
  STREET FLOW TRAVEL TIME(MIN.) =    2.01    Tc(MIN.) =    6.69
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =    6.990
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .5100
  S.C.S. CURVE NUMBER (AMC II) =    0
  AREA-AVERAGE RUNOFF COEFFICIENT =    0.516
  SUBAREA AREA(ACRES) =    0.85    SUBAREA RUNOFF(CFS) =    3.03
  TOTAL AREA(ACRES) =    0.9    PEAK FLOW RATE(CFS) =    3.37

END OF SUBAREA STREET FLOW HYDRAULICS:
DEPTH(FEET) = 0.25    HALFSTREET FLOOD WIDTH(FEET) =    6.35
FLOW VELOCITY(FEET/SEC.) =    6.45    DEPTH*VELOCITY(FT*FT/SEC.) =    1.63
LONGEST FLOWPATH FROM NODE      122.00 TO NODE      120.00 =    800.00 FEET.

*****
FLOW PROCESS FROM NODE      120.00 TO NODE      105.00 IS CODE =   31
-----
>>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) =    389.70  DOWNSTREAM(FEET) =    389.00
FLOW LENGTH(FEET) =    37.00    MANNING'S N =    0.011

```

DEPTH OF FLOW IN 12.0 INCH PIPE IS 6.7 INCHES  
 PIPE-FLOW VELOCITY(FEET/SEC.) = 7.51  
 ESTIMATED PIPE DIAMETER(INCH) = 12.00 NUMBER OF PIPES = 1  
 PIPE-FLOW(CFS) = 3.37  
 PIPE TRAVEL TIME(MIN.) = 0.08 Tc(MIN.) = 6.77  
 LONGEST FLOWPATH FROM NODE 122.00 TO NODE 105.00 = 837.00 FEET.

\*\*\*\*\*

FLOW PROCESS FROM NODE 120.00 TO NODE 105.00 IS CODE = 1

>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<  
 >>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<

=====

TOTAL NUMBER OF STREAMS = 2  
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 2 ARE:  
 TIME OF CONCENTRATION(MIN.) = 6.77  
 RAINFALL INTENSITY(INCH/HR) = 6.93  
 TOTAL STREAM AREA(ACRES) = 0.93  
 PEAK FLOW RATE(CFS) AT CONFLUENCE = 3.37

\*\* CONFLUENCE DATA \*\*

STREAM NUMBER	RUNOFF (CFS)	Tc (MIN.)	INTENSITY (INCH/HOUR)	AREA (ACRE)
1	5.16	37.31	2.306	3.66
2	3.37	6.77	6.935	0.93

RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO  
 CONFLUENCE FORMULA USED FOR 2 STREAMS.

\*\* PEAK FLOW RATE TABLE \*\*

STREAM NUMBER	RUNOFF (CFS)	Tc (MIN.)	INTENSITY (INCH/HOUR)
1	4.30	6.77	6.935
2	6.28	37.31	2.306

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:

PEAK FLOW RATE(CFS) = 6.28 Tc(MIN.) = 37.31  
 TOTAL AREA(ACRES) = 4.6  
 LONGEST FLOWPATH FROM NODE 108.00 TO NODE 105.00 = 1580.00 FEET.

\*\*\*\*\*

FLOW PROCESS FROM NODE 105.00 TO NODE 104.00 IS CODE = 31

>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<  
 >>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

=====

ELEVATION DATA: UPSTREAM(FEET) = 389.00 DOWNSTREAM(FEET) = 376.00  
 FLOW LENGTH(FEET) = 190.00 MANNING'S N = 0.011  
 DEPTH OF FLOW IN 12.0 INCH PIPE IS 6.6 INCHES  
 PIPE-FLOW VELOCITY(FEET/SEC.) = 14.20  
 ESTIMATED PIPE DIAMETER(INCH) = 12.00 NUMBER OF PIPES = 1  
 PIPE-FLOW(CFS) = 6.28  
 PIPE TRAVEL TIME(MIN.) = 0.22 Tc(MIN.) = 37.54  
 LONGEST FLOWPATH FROM NODE 108.00 TO NODE 104.00 = 1770.00 FEET.

```

*****
FLOW PROCESS FROM NODE      104.10 TO NODE      104.00 IS CODE = 81
-----
>>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
=====
100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 2.297
*USER SPECIFIED(SUBAREA):
USER-SPECIFIED RUNOFF COEFFICIENT = .3500
S.C.S. CURVE NUMBER (AMC II) = 0
AREA-AVERAGE RUNOFF COEFFICIENT = 0.5867
SUBAREA AREA(ACRES) = 0.10 SUBAREA RUNOFF(CFS) = 0.08
TOTAL AREA(ACRES) = 4.7 TOTAL RUNOFF(CFS) = 6.33
TC(MIN.) = 37.54

*****
FLOW PROCESS FROM NODE      104.00 TO NODE      103.00 IS CODE = 31
-----
>>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) = 374.30 DOWNSTREAM(FEET) = 374.10
FLOW LENGTH(FEET) = 35.00 MANNING'S N = 0.011
DEPTH OF FLOW IN 18.0 INCH PIPE IS 11.0 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) = 5.59
ESTIMATED PIPE DIAMETER(INCH) = 18.00 NUMBER OF PIPES = 1
PIPE-FLOW(CFS) = 6.33
PIPE TRAVEL TIME(MIN.) = 0.10 Tc(MIN.) = 37.64
LONGEST FLOWPATH FROM NODE 108.00 TO NODE 103.00 = 1805.00 FEET.

*****
FLOW PROCESS FROM NODE      103.00 TO NODE      102.00 IS CODE = 51
-----
>>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
>>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) = 374.10 DOWNSTREAM(FEET) = 374.00
CHANNEL LENGTH THRU SUBAREA(FEET) = 70.00 CHANNEL SLOPE = 0.0014
CHANNEL BASE(FEET) = 110.00 "Z" FACTOR = 2.000
MANNING'S FACTOR = 0.040 MAXIMUM DEPTH(FEET) = 1.00
CHANNEL FLOW THRU SUBAREA(CFS) = 6.33
FLOW VELOCITY(FEET/SEC.) = 0.39 FLOW DEPTH(FEET) = 0.15
TRAVEL TIME(MIN.) = 3.00 Tc(MIN.) = 40.64
LONGEST FLOWPATH FROM NODE 108.00 TO NODE 102.00 = 1875.00 FEET.

*****
FLOW PROCESS FROM NODE      103.00 TO NODE      102.00 IS CODE = 1
-----
>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
=====
TOTAL NUMBER OF STREAMS = 2
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 1 ARE:
TIME OF CONCENTRATION(MIN.) = 40.64
RAINFALL INTENSITY(INCH/HR) = 2.18

```

TOTAL STREAM AREA(ACRES) = 4.70  
PEAK FLOW RATE(CFS) AT CONFLUENCE = 6.33

\*\*\*\*\*  
FLOW PROCESS FROM NODE 133.00 TO NODE 132.00 IS CODE = 21  
-----

>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<  
=====

\*USER SPECIFIED(SUBAREA):  
USER-SPECIFIED RUNOFF COEFFICIENT = .3500  
S.C.S. CURVE NUMBER (AMC II) = 0  
INITIAL SUBAREA FLOW-LENGTH(FEET) = 50.00  
UPSTREAM ELEVATION(FEET) = 450.00  
DOWNSTREAM ELEVATION(FEET) = 449.70  
ELEVATION DIFFERENCE(FEET) = 0.30  
SUBAREA OVERLAND TIME OF FLOW(MIN.) = 11.318  
100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 4.978  
SUBAREA RUNOFF(CFS) = 0.04  
TOTAL AREA(ACRES) = 0.02 TOTAL RUNOFF(CFS) = 0.04

\*\*\*\*\*  
FLOW PROCESS FROM NODE 133.00 TO NODE 132.00 IS CODE = 7  
-----

>>>>USER SPECIFIED HYDROLOGY INFORMATION AT NODE<<<<  
=====

USER-SPECIFIED VALUES ARE AS FOLLOWS:  
TC(MIN) = 11.32 RAIN INTENSITY(INCH/HOUR) = 4.98  
TOTAL AREA(ACRES) = 0.02 TOTAL RUNOFF(CFS) = 0.10

\*\*\*\*\*  
FLOW PROCESS FROM NODE 132.00 TO NODE 131.00 IS CODE = 51  
-----

>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<  
>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<  
=====

ELEVATION DATA: UPSTREAM(FEET) = 449.70 DOWNSTREAM(FEET) = 448.70  
CHANNEL LENGTH THRU SUBAREA(FEET) = 200.00 CHANNEL SLOPE = 0.0050  
CHANNEL BASE(FEET) = 100.00 "Z" FACTOR = 2.000  
MANNING'S FACTOR = 0.040 MAXIMUM DEPTH(FEET) = 1.00  
100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 2.896

\*USER SPECIFIED(SUBAREA):  
USER-SPECIFIED RUNOFF COEFFICIENT = .4600  
S.C.S. CURVE NUMBER (AMC II) = 0  
TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) = 0.45  
TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) = 0.22  
AVERAGE FLOW DEPTH(FEET) = 0.02 TRAVEL TIME(MIN.) = 14.90  
Tc(MIN.) = 26.22  
SUBAREA AREA(ACRES) = 0.47 SUBAREA RUNOFF(CFS) = 0.63  
AREA-AVERAGE RUNOFF COEFFICIENT = 0.478  
TOTAL AREA(ACRES) = 0.5 PEAK FLOW RATE(CFS) = 0.68

END OF SUBAREA CHANNEL FLOW HYDRAULICS:  
DEPTH(FEET) = 0.03 FLOW VELOCITY(FEET/SEC.) = 0.25  
LONGEST FLOWPATH FROM NODE 133.00 TO NODE 131.00 = 250.00 FEET.

\*\*\*\*\*  
FLOW PROCESS FROM NODE 131.00 TO NODE 130.10 IS CODE = 51  
-----

>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<  
>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<  
=====

ELEVATION DATA: UPSTREAM(FEET) = 448.70 DOWNSTREAM(FEET) = 385.00  
CHANNEL LENGTH THRU SUBAREA(FEET) = 305.00 CHANNEL SLOPE = 0.2089  
CHANNEL BASE(FEET) = 0.00 "Z" FACTOR = 2.000  
MANNING'S FACTOR = 0.015 MAXIMUM DEPTH(FEET) = 1.00  
100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 2.866  
\*USER SPECIFIED(SUBAREA):  
USER-SPECIFIED RUNOFF COEFFICIENT = .4400  
S.C.S. CURVE NUMBER (AMC II) = 0  
TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) = 2.18  
TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) = 11.92  
AVERAGE FLOW DEPTH(FEET) = 0.30 TRAVEL TIME(MIN.) = 0.43  
Tc(MIN.) = 26.64  
SUBAREA AREA(ACRES) = 2.37 SUBAREA RUNOFF(CFS) = 2.99  
AREA-AVERAGE RUNOFF COEFFICIENT = 0.447  
TOTAL AREA(ACRES) = 2.9 PEAK FLOW RATE(CFS) = 3.67

END OF SUBAREA CHANNEL FLOW HYDRAULICS:  
DEPTH(FEET) = 0.37 FLOW VELOCITY(FEET/SEC.) = 13.45  
LONGEST FLOWPATH FROM NODE 133.00 TO NODE 130.10 = 555.00 FEET.

\*\*\*\*\*  
FLOW PROCESS FROM NODE 130.10 TO NODE 130.00 IS CODE = 51  
-----

>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<  
>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<  
=====

ELEVATION DATA: UPSTREAM(FEET) = 385.00 DOWNSTREAM(FEET) = 374.10  
CHANNEL LENGTH THRU SUBAREA(FEET) = 226.00 CHANNEL SLOPE = 0.0482  
CHANNEL BASE(FEET) = 0.00 "Z" FACTOR = 2.000  
MANNING'S FACTOR = 0.015 MAXIMUM DEPTH(FEET) = 1.00  
CHANNEL FLOW THRU SUBAREA(CFS) = 3.67  
FLOW VELOCITY(FEET/SEC.) = 7.84 FLOW DEPTH(FEET) = 0.48  
TRAVEL TIME(MIN.) = 0.48 Tc(MIN.) = 27.13  
LONGEST FLOWPATH FROM NODE 133.00 TO NODE 130.00 = 781.00 FEET.

\*\*\*\*\*  
FLOW PROCESS FROM NODE 130.00 TO NODE 102.00 IS CODE = 51  
-----

>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<  
>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<  
=====

ELEVATION DATA: UPSTREAM(FEET) = 374.10 DOWNSTREAM(FEET) = 374.00  
CHANNEL LENGTH THRU SUBAREA(FEET) = 110.00 CHANNEL SLOPE = 0.0009  
CHANNEL BASE(FEET) = 110.00 "Z" FACTOR = 2.000  
MANNING'S FACTOR = 0.040 MAXIMUM DEPTH(FEET) = 1.00  
100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 2.468  
\*USER SPECIFIED(SUBAREA):



USER-SPECIFIED RUNOFF COEFFICIENT = .4000  
 S.C.S. CURVE NUMBER (AMC II) = 0  
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) = 4.15  
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) = 0.28  
 AVERAGE FLOW DEPTH(FEET) = 0.13 TRAVEL TIME(MIN.) = 6.46  
 Tc(MIN.) = 33.58  
 SUBAREA AREA(ACRES) = 0.98 SUBAREA RUNOFF(CFS) = 0.97  
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.435  
 TOTAL AREA(ACRES) = 3.8 PEAK FLOW RATE(CFS) = 4.12

END OF SUBAREA CHANNEL FLOW HYDRAULICS:  
 DEPTH(FEET) = 0.13 FLOW VELOCITY(FEET/SEC.) = 0.28  
 LONGEST FLOWPATH FROM NODE 133.00 TO NODE 102.00 = 891.00 FEET.

\*\*\*\*\*  
 FLOW PROCESS FROM NODE 130.00 TO NODE 102.00 IS CODE = 1

>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<  
 >>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<

=====  
 TOTAL NUMBER OF STREAMS = 2  
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 2 ARE:  
 TIME OF CONCENTRATION(MIN.) = 33.58  
 RAINFALL INTENSITY(INCH/HR) = 2.47  
 TOTAL STREAM AREA(ACRES) = 3.84  
 PEAK FLOW RATE(CFS) AT CONFLUENCE = 4.12

\*\* CONFLUENCE DATA \*\*

STREAM NUMBER	RUNOFF (CFS)	Tc (MIN.)	INTENSITY (INCH/HOUR)	AREA (ACRE)
1	6.33	40.64	2.182	4.70
2	4.12	33.58	2.468	3.84

RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO  
 CONFLUENCE FORMULA USED FOR 2 STREAMS.

\*\* PEAK FLOW RATE TABLE \*\*

STREAM NUMBER	RUNOFF (CFS)	Tc (MIN.)	INTENSITY (INCH/HOUR)
1	9.72	33.58	2.468
2	9.98	40.64	2.182

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:  
 PEAK FLOW RATE(CFS) = 9.98 Tc(MIN.) = 40.64  
 TOTAL AREA(ACRES) = 8.5  
 LONGEST FLOWPATH FROM NODE 108.00 TO NODE 102.00 = 1875.00 FEET.

\*\*\*\*\*  
 FLOW PROCESS FROM NODE 102.00 TO NODE 102.00 IS CODE = 7

>>>>USER SPECIFIED HYDROLOGY INFORMATION AT NODE<<<<<

=====  
 USER-SPECIFIED VALUES ARE AS FOLLOWS:  
 TC(MIN) = 40.64 RAIN INTENSITY(INCH/HOUR) = 2.18

```

TOTAL AREA(ACRES) =      8.54    TOTAL RUNOFF(CFS) =      1.62

*****
FLOW PROCESS FROM NODE      102.00 TO NODE      101.00 IS CODE =   31
-----
>>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) =    371.00  DOWNSTREAM(FEET) =    357.80
FLOW LENGTH(FEET) =    150.00  MANNING'S N =    0.011
DEPTH OF FLOW IN    6.0 INCH PIPE IS    4.2 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) =    10.97
ESTIMATED PIPE DIAMETER(INCH) =    6.00    NUMBER OF PIPES =    1
PIPE-FLOW(CFS) =      1.62
PIPE TRAVEL TIME(MIN.) =    0.23    Tc(MIN.) =    40.87
LONGEST FLOWPATH FROM NODE    108.00 TO NODE    101.00 =    2025.00 FEET.

*****
FLOW PROCESS FROM NODE      102.00 TO NODE      101.00 IS CODE =    1
-----
>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
=====
TOTAL NUMBER OF STREAMS =    2
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM    1 ARE:
TIME OF CONCENTRATION(MIN.) =    40.87
RAINFALL INTENSITY(INCH/HR) =    2.17
TOTAL STREAM AREA(ACRES) =      8.54
PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.62

*****
FLOW PROCESS FROM NODE      152.00 TO NODE      151.00 IS CODE =   21
-----
>>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
=====
*USER SPECIFIED(SUBAREA):
USER-SPECIFIED RUNOFF COEFFICIENT = .3500
S.C.S. CURVE NUMBER (AMC II) =    0
INITIAL SUBAREA FLOW-LENGTH(FEET) =    100.00
UPSTREAM ELEVATION(FEET) =    517.20
DOWNSTREAM ELEVATION(FEET) =    502.00
ELEVATION DIFFERENCE(FEET) =    15.20
SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.267
WARNING: THE MAXIMUM OVERLAND FLOW SLOPE, 10.%, IS USED IN Tc CALCULATION!
100 YEAR RAINFALL INTENSITY(INCH/HOUR) =    7.288
SUBAREA RUNOFF(CFS) =      0.20
TOTAL AREA(ACRES) =      0.08    TOTAL RUNOFF(CFS) =      0.20

*****
FLOW PROCESS FROM NODE      151.00 TO NODE      150.00 IS CODE =   51
-----
>>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
>>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) =    502.00  DOWNSTREAM(FEET) =    375.00

```

CHANNEL LENGTH THRU SUBAREA(FEET) = 1249.00    CHANNEL SLOPE = 0.1017  
 CHANNEL BASE(FEET) = 10.00    "Z" FACTOR = 10.000  
 MANNING'S FACTOR = 0.040    MAXIMUM DEPTH(FEET) = 1.00  
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 4.377  
 \*USER SPECIFIED(SUBAREA):  
 USER-SPECIFIED RUNOFF COEFFICIENT = .4400  
 S.C.S. CURVE NUMBER (AMC II) = 0  
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) = 4.14  
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) = 2.76  
 AVERAGE FLOW DEPTH(FEET) = 0.13    TRAVEL TIME(MIN.) = 7.55  
 Tc(MIN.) = 13.82  
 SUBAREA AREA(ACRES) = 3.95    SUBAREA RUNOFF(CFS) = 7.61  
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.438  
 TOTAL AREA(ACRES) = 4.0    PEAK FLOW RATE(CFS) = 7.73  
  
 END OF SUBAREA CHANNEL FLOW HYDRAULICS:  
 DEPTH(FEET) = 0.19    FLOW VELOCITY(FEET/SEC.) = 3.50  
 LONGEST FLOWPATH FROM NODE 152.00 TO NODE 150.00 = 1349.00 FEET.

\*\*\*\*\*

FLOW PROCESS FROM NODE 150.00 TO NODE 101.00 IS CODE = 51

>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<

>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<

ELEVATION DATA: UPSTREAM(FEET) = 375.00    DOWNSTREAM(FEET) = 357.80  
 CHANNEL LENGTH THRU SUBAREA(FEET) = 1298.00    CHANNEL SLOPE = 0.0133  
 CHANNEL BASE(FEET) = 2.00    "Z" FACTOR = 2.000  
 MANNING'S FACTOR = 0.040    MAXIMUM DEPTH(FEET) = 2.00  
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 3.453  
 \*USER SPECIFIED(SUBAREA):  
 USER-SPECIFIED RUNOFF COEFFICIENT = .4000  
 S.C.S. CURVE NUMBER (AMC II) = 0  
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) = 20.11  
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) = 3.52  
 AVERAGE FLOW DEPTH(FEET) = 1.26    TRAVEL TIME(MIN.) = 6.14  
 Tc(MIN.) = 19.95  
 SUBAREA AREA(ACRES) = 17.75    SUBAREA RUNOFF(CFS) = 24.52  
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.407  
 TOTAL AREA(ACRES) = 21.8    PEAK FLOW RATE(CFS) = 30.61

END OF SUBAREA CHANNEL FLOW HYDRAULICS:  
 DEPTH(FEET) = 1.54    FLOW VELOCITY(FEET/SEC.) = 3.92  
 LONGEST FLOWPATH FROM NODE 152.00 TO NODE 101.00 = 2647.00 FEET.

\*\*\*\*\*

FLOW PROCESS FROM NODE 150.00 TO NODE 101.00 IS CODE = 1

>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<

>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<

TOTAL NUMBER OF STREAMS = 2  
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 2 ARE:  
 TIME OF CONCENTRATION(MIN.) = 19.95

RAINFALL INTENSITY(INCH/HR) = 3.45  
TOTAL STREAM AREA(ACRES) = 21.78  
PEAK FLOW RATE(CFS) AT CONFLUENCE = 30.61

\*\* CONFLUENCE DATA \*\*

STREAM NUMBER	RUNOFF (CFS)	Tc (MIN.)	INTENSITY (INCH/HOUR)	AREA (ACRE)
1	1.62	40.87	2.175	8.54
2	30.61	19.95	3.453	21.78

RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO  
CONFLUENCE FORMULA USED FOR 2 STREAMS.

\*\* PEAK FLOW RATE TABLE \*\*

STREAM NUMBER	RUNOFF (CFS)	Tc (MIN.)	INTENSITY (INCH/HOUR)
1	31.41	19.95	3.453
2	20.90	40.87	2.175

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:

PEAK FLOW RATE(CFS) = 31.41 Tc(MIN.) = 19.95  
TOTAL AREA(ACRES) = 30.3  
LONGEST FLOWPATH FROM NODE 152.00 TO NODE 101.00 = 2647.00 FEET.

\*\*\*\*\*

FLOW PROCESS FROM NODE 101.00 TO NODE 100.00 IS CODE = 31

-----

>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<

>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<

=====

ELEVATION DATA: UPSTREAM(FEET) = 357.80 DOWNSTREAM(FEET) = 357.60

FLOW LENGTH(FEET) = 10.00 MANNING'S N = 0.013

DEPTH OF FLOW IN 27.0 INCH PIPE IS 17.2 INCHES

PIPE-FLOW VELOCITY(FEET/SEC.) = 11.74

ESTIMATED PIPE DIAMETER(INCH) = 27.00 NUMBER OF PIPES = 1

PIPE-FLOW(CFS) = 31.41

PIPE TRAVEL TIME(MIN.) = 0.01 Tc(MIN.) = 19.97

LONGEST FLOWPATH FROM NODE 152.00 TO NODE 100.00 = 2657.00 FEET.

\*\*\*\*\*

FLOW PROCESS FROM NODE 205.00 TO NODE 204.00 IS CODE = 21

-----

>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<

=====

\*USER SPECIFIED(SUBAREA):

USER-SPECIFIED RUNOFF COEFFICIENT = .3500

S.C.S. CURVE NUMBER (AMC II) = 0

INITIAL SUBAREA FLOW-LENGTH(FEET) = 100.00

UPSTREAM ELEVATION(FEET) = 526.50

DOWNSTREAM ELEVATION(FEET) = 523.00

ELEVATION DIFFERENCE(FEET) = 3.50

SUBAREA OVERLAND TIME OF FLOW(MIN.) = 8.892

100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 5.816

SUBAREA RUNOFF(CFS) = 0.47

```

TOTAL AREA(ACRES) =          0.23   TOTAL RUNOFF(CFS) =          0.47

*****
FLOW PROCESS FROM NODE      204.00 TO NODE      203.00 IS CODE =   51
-----
>>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
>>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) =    523.00   DOWNSTREAM(FEET) =    430.90
CHANNEL LENGTH THRU SUBAREA(FEET) =  1356.00   CHANNEL SLOPE =    0.0679
CHANNEL BASE(FEET) =    10.00   "Z" FACTOR =    5.000
MANNING'S FACTOR = 0.040   MAXIMUM DEPTH(FEET) =    5.00
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =    4.136
*USER SPECIFIED(SUBAREA):
USER-SPECIFIED RUNOFF COEFFICIENT = .3500
S.C.S. CURVE NUMBER (AMC II) =    0
TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =    10.56
TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =    3.65
AVERAGE FLOW DEPTH(FEET) =    0.26   TRAVEL TIME(MIN.) =    6.19
Tc(MIN.) =    15.08
SUBAREA AREA(ACRES) =    13.60   SUBAREA RUNOFF(CFS) =    19.69
AREA-AVERAGE RUNOFF COEFFICIENT =    0.350
TOTAL AREA(ACRES) =    13.8   PEAK FLOW RATE(CFS) =    20.02

END OF SUBAREA CHANNEL FLOW HYDRAULICS:
DEPTH(FEET) =    0.37   FLOW VELOCITY(FEET/SEC.) =    4.55
LONGEST FLOWPATH FROM NODE    205.00 TO NODE    203.00 =    1456.00 FEET.

*****
FLOW PROCESS FROM NODE      204.00 TO NODE      203.00 IS CODE =    1
-----
>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
=====
TOTAL NUMBER OF STREAMS =    2
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
TIME OF CONCENTRATION(MIN.) =    15.08
RAINFALL INTENSITY(INCH/HR) =    4.14
TOTAL STREAM AREA(ACRES) =    13.83
PEAK FLOW RATE(CFS) AT CONFLUENCE =    20.02

*****
FLOW PROCESS FROM NODE      203.20 TO NODE      203.20 IS CODE =    7
-----
>>>>>USER SPECIFIED HYDROLOGY INFORMATION AT NODE<<<<<
=====
USER-SPECIFIED VALUES ARE AS FOLLOWS:
TC(MIN) =    18.12   RAIN INTENSITY(INCH/HOUR) =    3.67
TOTAL AREA(ACRES) =    16.20   TOTAL RUNOFF(CFS) =    24.26

*****
FLOW PROCESS FROM NODE      203.10 TO NODE      203.10 IS CODE =   51
-----
>>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
>>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<

```

```

=====
ELEVATION DATA: UPSTREAM(FEET) =    455.00  DOWNSTREAM(FEET) =    430.90
CHANNEL LENGTH THRU SUBAREA(FEET) =    98.00  CHANNEL SLOPE =    0.2459
CHANNEL BASE(FEET) =    10.00  "Z" FACTOR =    5.000
MANNING'S FACTOR = 0.040  MAXIMUM DEPTH(FEET) =    5.00
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =    3.646
*USER SPECIFIED(SUBAREA):
USER-SPECIFIED RUNOFF COEFFICIENT = .3500
S.C.S. CURVE NUMBER (AMC II) =    0
TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =    25.29
TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =    7.48
AVERAGE FLOW DEPTH(FEET) =    0.29  TRAVEL TIME(MIN.) =    0.22
Tc(MIN.) =    18.34
SUBAREA AREA(ACRES) =    1.62  SUBAREA RUNOFF(CFS) =    2.07
AREA-AVERAGE RUNOFF COEFFICIENT =    0.402
TOTAL AREA(ACRES) =    17.8  PEAK FLOW RATE(CFS) =    26.14

END OF SUBAREA CHANNEL FLOW HYDRAULICS:
DEPTH(FEET) = 0.30  FLOW VELOCITY(FEET/SEC.) =    7.57
LONGEST FLOWPATH FROM NODE    152.00 TO NODE    203.10 =    2745.00 FEET.

*****
FLOW PROCESS FROM NODE    203.10 TO NODE    203.00 IS CODE =    1
=====
>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
>>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
=====
TOTAL NUMBER OF STREAMS =    2
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM    2 ARE:
TIME OF CONCENTRATION(MIN.) =    18.34
RAINFALL INTENSITY(INCH/HR) =    3.65
TOTAL STREAM AREA(ACRES) =    17.82
PEAK FLOW RATE(CFS) AT CONFLUENCE =    26.14

** CONFLUENCE DATA **
STREAM      RUNOFF      Tc      INTENSITY      AREA
NUMBER      (CFS)      (MIN.)  (INCH/HOUR)  (ACRE)
    1        20.02    15.08      4.136      13.83
    2        26.14    18.34      3.646      17.82

RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
CONFLUENCE FORMULA USED FOR    2 STREAMS.

** PEAK FLOW RATE TABLE **
STREAM      RUNOFF      Tc      INTENSITY
NUMBER      (CFS)      (MIN.)  (INCH/HOUR)
    1        41.52    15.08      4.136
    2        43.79    18.34      3.646

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
PEAK FLOW RATE(CFS) =    43.79  Tc(MIN.) =    18.34
TOTAL AREA(ACRES) =    31.7
LONGEST FLOWPATH FROM NODE    152.00 TO NODE    203.00 =    2745.00 FEET.

```

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*****
FLOW PROCESS FROM NODE      203.00 TO NODE      202.00 IS CODE =  51
-----
>>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
>>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) =    430.90  DOWNSTREAM(FEET) =    419.00
CHANNEL LENGTH THRU SUBAREA(FEET) =    395.00  CHANNEL SLOPE =    0.0301
CHANNEL BASE(FEET) =    10.00  "Z" FACTOR =    5.000
MANNING'S FACTOR = 0.040  MAXIMUM DEPTH(FEET) =    5.00
100 YEAR RAINFALL INTENSITY(INCH/HOUR) =    3.469
*USER SPECIFIED(SUBAREA):
USER-SPECIFIED RUNOFF COEFFICIENT = .3500
S.C.S. CURVE NUMBER (AMC II) =    0
TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =    45.14
TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =    4.47
AVERAGE FLOW DEPTH(FEET) =    0.74  TRAVEL TIME(MIN.) =    1.47
Tc(MIN.) =    19.81
SUBAREA AREA(ACRES) =    2.23  SUBAREA RUNOFF(CFS) =    2.71
AREA-AVERAGE RUNOFF COEFFICIENT =    0.378
TOTAL AREA(ACRES) =    33.9  PEAK FLOW RATE(CFS) =    44.37

END OF SUBAREA CHANNEL FLOW HYDRAULICS:
DEPTH(FEET) = 0.73  FLOW VELOCITY(FEET/SEC.) =    4.46
LONGEST FLOWPATH FROM NODE    152.00 TO NODE    202.00 =    3140.00 FEET.

*****
FLOW PROCESS FROM NODE      203.00 TO NODE      202.00 IS CODE =  1
-----
>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
=====
TOTAL NUMBER OF STREAMS = 2
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 1 ARE:
TIME OF CONCENTRATION(MIN.) =    19.81
RAINFALL INTENSITY(INCH/HR) =    3.47
TOTAL STREAM AREA(ACRES) =    33.88
PEAK FLOW RATE(CFS) AT CONFLUENCE =    44.37

*****
FLOW PROCESS FROM NODE      202.10 TO NODE      202.10 IS CODE =  7
-----
>>>>>USER SPECIFIED HYDROLOGY INFORMATION AT NODE<<<<<
=====
USER-SPECIFIED VALUES ARE AS FOLLOWS:
TC(MIN) = 19.49  RAIN INTENSITY(INCH/HOUR) =    3.51
TOTAL AREA(ACRES) =    2.40  TOTAL RUNOFF(CFS) =    4.03

*****
FLOW PROCESS FROM NODE      202.10 TO NODE      202.00 IS CODE =  51
-----
>>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
>>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) =    445.00  DOWNSTREAM(FEET) =    419.00

```

CHANNEL LENGTH THRU SUBAREA(Feet) = 98.00 CHANNEL SLOPE = 0.2653  
 CHANNEL BASE(Feet) = 0.00 "Z" FACTOR = 2.000  
 MANNING'S FACTOR = 0.015 MAXIMUM DEPTH(Feet) = 1.00  
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 3.494  
 \*USER SPECIFIED(SUBAREA):  
 USER-SPECIFIED RUNOFF COEFFICIENT = .3500  
 S.C.S. CURVE NUMBER (AMC II) = 0  
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) = 4.54  
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(Feet/Sec.) = 15.83  
 AVERAGE FLOW DEPTH(Feet) = 0.38 TRAVEL TIME(Min.) = 0.10  
 Tc(Min.) = 19.59  
 SUBAREA AREA(ACRES) = 0.83 SUBAREA RUNOFF(CFS) = 1.01  
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.446  
 TOTAL AREA(ACRES) = 3.2 PEAK FLOW RATE(CFS) = 5.03

END OF SUBAREA CHANNEL FLOW HYDRAULICS:  
 DEPTH(Feet) = 0.39 FLOW VELOCITY(Feet/Sec.) = 16.22  
 LONGEST FLOWPATH FROM NODE 152.00 TO NODE 202.00 = 2843.00 FEET.

\*\*\*\*\*

FLOW PROCESS FROM NODE 202.10 TO NODE 202.00 IS CODE = 1

-----

>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<  
 >>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<

=====

TOTAL NUMBER OF STREAMS = 2  
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 2 ARE:  
 TIME OF CONCENTRATION(Min.) = 19.59  
 RAINFALL INTENSITY(INCH/HR) = 3.49  
 TOTAL STREAM AREA(ACRES) = 3.23  
 PEAK FLOW RATE(CFS) AT CONFLUENCE = 5.03

# \*\* CONFLUENCE DATA \*\*

STREAM NUMBER	RUNOFF (CFS)	Tc (Min.)	INTENSITY (INCH/HOUR)	AREA (ACRE)
1	44.37	19.81	3.469	33.88
2	5.03	19.59	3.494	3.23

RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO  
 CONFLUENCE FORMULA USED FOR 2 STREAMS.

# \*\* PEAK FLOW RATE TABLE \*\*

STREAM NUMBER	RUNOFF (CFS)	Tc (Min.)	INTENSITY (INCH/HOUR)
1	49.09	19.59	3.494
2	49.37	19.81	3.469

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:  
 PEAK FLOW RATE(CFS) = 49.37 Tc(Min.) = 19.81  
 TOTAL AREA(ACRES) = 37.1  
 LONGEST FLOWPATH FROM NODE 152.00 TO NODE 202.00 = 3140.00 FEET.

\*\*\*\*\*

FLOW PROCESS FROM NODE 202.00 TO NODE 201.00 IS CODE = 51



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-----
>>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
>>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) = 419.00 DOWNSTREAM(FEET) = 411.00
CHANNEL LENGTH THRU SUBAREA(FEET) = 458.00 CHANNEL SLOPE = 0.0175
CHANNEL BASE(FEET) = 40.00 "Z" FACTOR = 5.000
MANNING'S FACTOR = 0.040 MAXIMUM DEPTH(FEET) = 5.00
100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 3.189
*USER SPECIFIED(SUBAREA):
USER-SPECIFIED RUNOFF COEFFICIENT = .3500
S.C.S. CURVE NUMBER (AMC II) = 0
TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) = 51.93
TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) = 2.76
AVERAGE FLOW DEPTH(FEET) = 0.45 TRAVEL TIME(MIN.) = 2.76
Tc(MIN.) = 22.57
SUBAREA AREA(ACRES) = 4.59 SUBAREA RUNOFF(CFS) = 5.12
AREA-AVERAGE RUNOFF COEFFICIENT = 0.380
TOTAL AREA(ACRES) = 41.7 PEAK FLOW RATE(CFS) = 50.50

END OF SUBAREA CHANNEL FLOW HYDRAULICS:
DEPTH(FEET) = 0.44 FLOW VELOCITY(FEET/SEC.) = 2.73
LONGEST FLOWPATH FROM NODE 152.00 TO NODE 201.00 = 3598.00 FEET.

*****
FLOW PROCESS FROM NODE 202.00 TO NODE 201.00 IS CODE = 1
-----
>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
=====
TOTAL NUMBER OF STREAMS = 2
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 1 ARE:
TIME OF CONCENTRATION(MIN.) = 22.57
RAINFALL INTENSITY(INCH/HR) = 3.19
TOTAL STREAM AREA(ACRES) = 41.70
PEAK FLOW RATE(CFS) AT CONFLUENCE = 50.50

*****
FLOW PROCESS FROM NODE 258.00 TO NODE 257.00 IS CODE = 21
-----
>>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
=====
*USER SPECIFIED(SUBAREA):
USER-SPECIFIED RUNOFF COEFFICIENT = .3500
S.C.S. CURVE NUMBER (AMC II) = 0
INITIAL SUBAREA FLOW-LENGTH(FEET) = 50.00
UPSTREAM ELEVATION(FEET) = 491.00
DOWNSTREAM ELEVATION(FEET) = 490.70
ELEVATION DIFFERENCE(FEET) = 0.30
SUBAREA OVERLAND TIME OF FLOW(MIN.) = 11.318
100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 4.978
SUBAREA RUNOFF(CFS) = 0.05
TOTAL AREA(ACRES) = 0.03 TOTAL RUNOFF(CFS) = 0.05

*****

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FLOW PROCESS FROM NODE      258.00 TO NODE      257.00 IS CODE =    7
-----
>>>>>USER SPECIFIED HYDROLOGY INFORMATION AT NODE<<<<<
=====
USER-SPECIFIED VALUES ARE AS FOLLOWS:
TC(MIN) =  11.32    RAIN INTENSITY(INCH/HOUR) =  4.98
TOTAL AREA(ACRES) =    0.03    TOTAL RUNOFF(CFS) =    0.10

*****
FLOW PROCESS FROM NODE      257.00 TO NODE      256.00 IS CODE =   51
-----
>>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
>>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) =    490.70  DOWNSTREAM(FEET) =    482.00
CHANNEL LENGTH THRU SUBAREA(FEET) =    565.00  CHANNEL SLOPE =    0.0154
CHANNEL BASE(FEET) =    32.00    "Z" FACTOR =    2.000
MANNING'S FACTOR = 0.040    MAXIMUM DEPTH(FEET) =    1.00
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =    2.866
*USER SPECIFIED(SUBAREA):
USER-SPECIFIED RUNOFF COEFFICIENT = .4300
S.C.S. CURVE NUMBER (AMC II) =    0
TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =    0.85
TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =    0.61
AVERAGE FLOW DEPTH(FEET) =    0.04    TRAVEL TIME(MIN.) =    15.32
Tc(MIN.) =    26.63
SUBAREA AREA(ACRES) =    1.10    SUBAREA RUNOFF(CFS) =    1.36
AREA-AVERAGE RUNOFF COEFFICIENT =    0.437
TOTAL AREA(ACRES) =    1.1    PEAK FLOW RATE(CFS) =    1.41

END OF SUBAREA CHANNEL FLOW HYDRAULICS:
DEPTH(FEET) = 0.06    FLOW VELOCITY(FEET/SEC.) =    0.69
LONGEST FLOWPATH FROM NODE      258.00 TO NODE      256.00 =    615.00 FEET.

*****
FLOW PROCESS FROM NODE      256.00 TO NODE      255.00 IS CODE =   61
-----
>>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>(STANDARD CURB SECTION USED)<<<<<
=====
UPSTREAM ELEVATION(FEET) =    482.00  DOWNSTREAM ELEVATION(FEET) =    464.00
STREET LENGTH(FEET) =    560.00  CURB HEIGHT(INCHES) =    6.0
STREET HALFWIDTH(FEET) =    16.00

DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =    10.00
INSIDE STREET CROSSFALL(DECIMAL) =    0.020
OUTSIDE STREET CROSSFALL(DECIMAL) =    0.020

SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =    1
STREET PARKWAY CROSSFALL(DECIMAL) =    0.050
Manning's FRICTION FACTOR for Streetflow Section(curbs-to-curbs) =    0.0130
Manning's FRICTION FACTOR for Back-of-Walk Flow Section =    0.0200

**TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =    3.78

```

STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:  
 STREET FLOW DEPTH(FEET) = 0.30  
 HALFSTREET FLOOD WIDTH(FEET) = 8.70  
 AVERAGE FLOW VELOCITY(FEET/SEC.) = 4.32  
 PRODUCT OF DEPTH&VELOCITY(FT\*FT/SEC.) = 1.30  
 STREET FLOW TRAVEL TIME(MIN.) = 2.16 Tc(MIN.) = 28.79  
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 2.726  
 \*USER SPECIFIED(SUBAREA):  
 USER-SPECIFIED RUNOFF COEFFICIENT = .5000  
 S.C.S. CURVE NUMBER (AMC II) = 0  
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.485  
 SUBAREA AREA(ACRES) = 3.47 SUBAREA RUNOFF(CFS) = 4.73  
 TOTAL AREA(ACRES) = 4.6 PEAK FLOW RATE(CFS) = 6.07

END OF SUBAREA STREET FLOW HYDRAULICS:  
 DEPTH(FEET) = 0.34 HALFSTREET FLOOD WIDTH(FEET) = 10.73  
 FLOW VELOCITY(FEET/SEC.) = 4.79 DEPTH\*VELOCITY(FT\*FT/SEC.) = 1.63  
 LONGEST FLOWPATH FROM NODE 258.00 TO NODE 255.00 = 1175.00 FEET.

\*\*\*\*\*

FLOW PROCESS FROM NODE 255.00 TO NODE 254.00 IS CODE = 31

>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<

>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<

=====

ELEVATION DATA: UPSTREAM(FEET) = 461.00 DOWNSTREAM(FEET) = 456.00  
 FLOW LENGTH(FEET) = 260.00 MANNING'S N = 0.011  
 DEPTH OF FLOW IN 15.0 INCH PIPE IS 8.3 INCHES  
 PIPE-FLOW VELOCITY(FEET/SEC.) = 8.75  
 ESTIMATED PIPE DIAMETER(INCH) = 15.00 NUMBER OF PIPES = 1  
 PIPE-FLOW(CFS) = 6.07  
 PIPE TRAVEL TIME(MIN.) = 0.50 Tc(MIN.) = 29.29  
 LONGEST FLOWPATH FROM NODE 258.00 TO NODE 254.00 = 1435.00 FEET.

\*\*\*\*\*

FLOW PROCESS FROM NODE 254.00 TO NODE 253.00 IS CODE = 51

>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<

>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<

=====

ELEVATION DATA: UPSTREAM(FEET) = 456.00 DOWNSTREAM(FEET) = 434.00  
 CHANNEL LENGTH THRU SUBAREA(FEET) = 142.00 CHANNEL SLOPE = 0.1549  
 CHANNEL BASE(FEET) = 0.00 "Z" FACTOR = 2.000  
 MANNING'S FACTOR = 0.015 MAXIMUM DEPTH(FEET) = 1.00  
 CHANNEL FLOW THRU SUBAREA(CFS) = 6.07  
 FLOW VELOCITY(FEET/SEC.) = 13.74 FLOW DEPTH(FEET) = 0.47  
 TRAVEL TIME(MIN.) = 0.17 Tc(MIN.) = 29.46  
 LONGEST FLOWPATH FROM NODE 258.00 TO NODE 253.00 = 1577.00 FEET.

\*\*\*\*\*

FLOW PROCESS FROM NODE 253.00 TO NODE 252.10 IS CODE = 31

>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<

>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<

```

=====
ELEVATION DATA: UPSTREAM(FEET) = 530.60 DOWNSTREAM(FEET) = 515.76
FLOW LENGTH(FEET) = 14.30 MANNING'S N = 0.011
DEPTH OF FLOW IN 6.0 INCH PIPE IS 4.5 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) = 38.06
ESTIMATED PIPE DIAMETER(INCH) = 6.00 NUMBER OF PIPES = 1
PIPE-FLOW(CFS) = 6.07
PIPE TRAVEL TIME(MIN.) = 0.01 Tc(MIN.) = 29.47
LONGEST FLOWPATH FROM NODE 258.00 TO NODE 252.10 = 1591.30 FEET.

*****
FLOW PROCESS FROM NODE 252.10 TO NODE 252.00 IS CODE = 31
=====

>>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) = 515.76 DOWNSTREAM(FEET) = 515.60
FLOW LENGTH(FEET) = 13.00 MANNING'S N = 0.011
DEPTH OF FLOW IN 15.0 INCH PIPE IS 9.6 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) = 7.35
ESTIMATED PIPE DIAMETER(INCH) = 15.00 NUMBER OF PIPES = 1
PIPE-FLOW(CFS) = 6.07
PIPE TRAVEL TIME(MIN.) = 0.03 Tc(MIN.) = 29.50
LONGEST FLOWPATH FROM NODE 258.00 TO NODE 252.00 = 1604.30 FEET.

*****
FLOW PROCESS FROM NODE 252.00 TO NODE 251.00 IS CODE = 51
=====

>>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
>>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) = 415.60 DOWNSTREAM(FEET) = 415.00
CHANNEL LENGTH THRU SUBAREA(FEET) = 40.00 CHANNEL SLOPE = 0.0150
CHANNEL BASE(FEET) = 27.00 "Z" FACTOR = 2.000
MANNING'S FACTOR = 0.040 MAXIMUM DEPTH(FEET) = 1.00
100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 2.655
*USER SPECIFIED(SUBAREA):
USER-SPECIFIED RUNOFF COEFFICIENT = .3500
S.C.S. CURVE NUMBER (AMC II) = 0
TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) = 6.19
TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) = 1.37
AVERAGE FLOW DEPTH(FEET) = 0.16 TRAVEL TIME(MIN.) = 0.49
Tc(MIN.) = 29.98
SUBAREA AREA(ACRES) = 0.25 SUBAREA RUNOFF(CFS) = 0.23
AREA-AVERAGE RUNOFF COEFFICIENT = 0.478
TOTAL AREA(ACRES) = 4.8 PEAK FLOW RATE(CFS) = 6.15

END OF SUBAREA CHANNEL FLOW HYDRAULICS:
DEPTH(FEET) = 0.16 FLOW VELOCITY(FEET/SEC.) = 1.36
LONGEST FLOWPATH FROM NODE 258.00 TO NODE 251.00 = 1644.30 FEET.

*****
FLOW PROCESS FROM NODE 251.00 TO NODE 251.00 IS CODE = 7
=====

```

```

>>>>USER SPECIFIED HYDROLOGY INFORMATION AT NODE<<<<
=====
USER-SPECIFIED VALUES ARE AS FOLLOWS:
TC(MIN) = 29.98    RAIN INTENSITY(INCH/HOUR) = 2.66
TOTAL AREA(ACRES) = 4.80    TOTAL RUNOFF(CFS) = 2.72

*****
FLOW PROCESS FROM NODE 251.00 TO NODE 250.00 IS CODE = 31
-----
>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) = 411.50    DOWNSTREAM(FEET) = 411.00
FLOW LENGTH(FEET) = 21.00    MANNING'S N = 0.011
DEPTH OF FLOW IN 9.0 INCH PIPE IS 6.8 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) = 7.57
ESTIMATED PIPE DIAMETER(INCH) = 9.00    NUMBER OF PIPES = 1
PIPE-FLOW(CFS) = 2.72
PIPE TRAVEL TIME(MIN.) = 0.05    Tc(MIN.) = 30.03
LONGEST FLOWPATH FROM NODE 258.00 TO NODE 250.00 = 1665.30 FEET.

*****
FLOW PROCESS FROM NODE 250.00 TO NODE 201.00 IS CODE = 1
-----
>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<
>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<
=====
TOTAL NUMBER OF STREAMS = 2
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 2 ARE:
TIME OF CONCENTRATION(MIN.) = 30.03
RAINFALL INTENSITY(INCH/HR) = 2.65
TOTAL STREAM AREA(ACRES) = 4.80
PEAK FLOW RATE(CFS) AT CONFLUENCE = 2.72

** CONFLUENCE DATA **
STREAM    RUNOFF    Tc    INTENSITY    AREA
NUMBER    (CFS)    (MIN.)    (INCH/HOUR)    (ACRE)
1         50.50    22.57    3.189    41.70
2         2.72    30.03    2.653    4.80

RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
CONFLUENCE FORMULA USED FOR 2 STREAMS.

** PEAK FLOW RATE TABLE **
STREAM    RUNOFF    Tc    INTENSITY
NUMBER    (CFS)    (MIN.)    (INCH/HOUR)
1         52.55    22.57    3.189
2         44.73    30.03    2.653

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
PEAK FLOW RATE(CFS) = 52.55    Tc(MIN.) = 22.57
TOTAL AREA(ACRES) = 46.5
LONGEST FLOWPATH FROM NODE 152.00 TO NODE 201.00 = 3598.00 FEET.

```

```

*****
FLOW PROCESS FROM NODE      201.00 TO NODE      201.10 IS CODE =  41
-----
>>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) =    411.00  DOWNSTREAM(FEET) =    410.40
FLOW LENGTH(FEET) =    30.00  MANNING'S N =    0.013
DEPTH OF FLOW IN  27.0 INCH PIPE IS  15.3 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) =    11.29
GIVEN PIPE DIAMETER(INCH) =    27.00  NUMBER OF PIPES =    2
PIPE-FLOW(CFS) =    52.55
PIPE TRAVEL TIME(MIN.) =    0.04  Tc(MIN.) =    22.62
LONGEST FLOWPATH FROM NODE    152.00 TO NODE    201.10 =    3628.00 FEET.

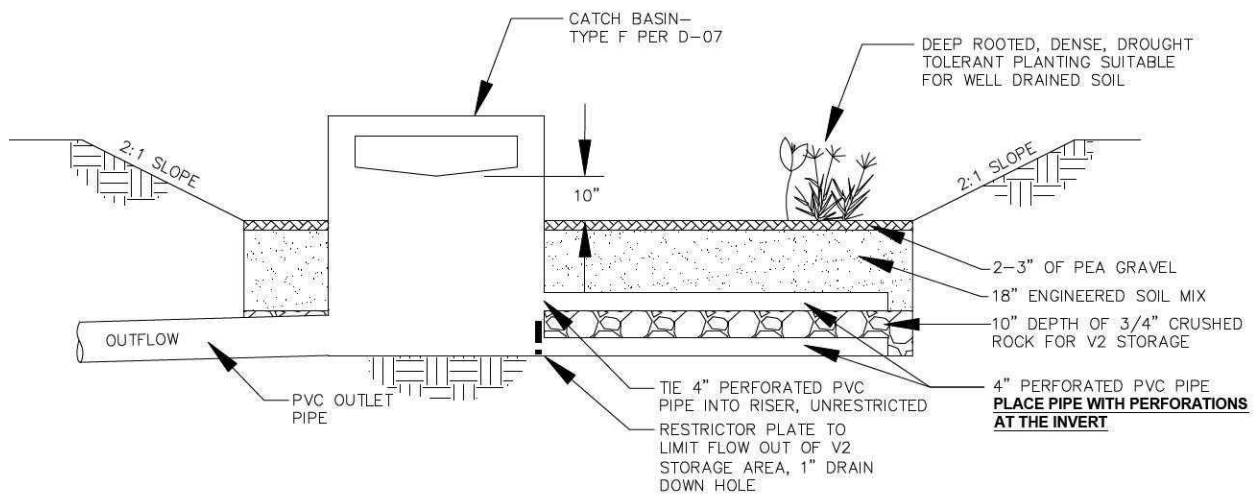
*****
FLOW PROCESS FROM NODE      201.10 TO NODE      200.00 IS CODE =  51
-----
>>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
>>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) =    410.40  DOWNSTREAM(FEET) =    404.00
CHANNEL LENGTH THRU SUBAREA(FEET) =    320.00  CHANNEL SLOPE =    0.0200
CHANNEL BASE(FEET) =    30.00  "Z" FACTOR =    3.000
MANNING'S FACTOR = 0.040  MAXIMUM DEPTH(FEET) =    5.00
100 YEAR RAINFALL INTENSITY(INCH/HOUR) =    3.047
*USER SPECIFIED(SUBAREA):
USER-SPECIFIED RUNOFF COEFFICIENT = .3500
S.C.S. CURVE NUMBER (AMC II) =    0
TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =    55.36
TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =    3.31
AVERAGE FLOW DEPTH(FEET) =    0.53  TRAVEL TIME(MIN.) =    1.61
Tc(MIN.) =    24.23
SUBAREA AREA(ACRES) =    5.27  SUBAREA RUNOFF(CFS) =    5.62
AREA-AVERAGE RUNOFF COEFFICIENT =    0.361
TOTAL AREA(ACRES) =    51.8  PEAK FLOW RATE(CFS) =    56.99

END OF SUBAREA CHANNEL FLOW HYDRAULICS:
DEPTH(FEET) =    0.54  FLOW VELOCITY(FEET/SEC.) =    3.35
LONGEST FLOWPATH FROM NODE    152.00 TO NODE    200.00 =    3948.00 FEET.
=====
END OF STUDY SUMMARY:
TOTAL AREA(ACRES)      =    51.8  TC(MIN.) =    24.23
PEAK FLOW RATE(CFS)    =    56.99
=====
END OF RATIONAL METHOD ANALYSIS

```

## D. DETENTION CALCULATIONS

### Basin Outlet Detail



### BIORETENTION BASIN OUTLET DETAIL, TYP

NOT TO SCALE

## Storage and Capacity Calculations

**Table 2.0- Detention Flow Results Summary**

Basin	Q <sub>IN</sub>	Q <sub>OUT</sub>	ΔQ	Max Depth (ft)
A	9.98	1.62	8.36	0.91
B	6.10	2.72	3.38	1.33
Total	16.08	4.34	11.74	

**Table 2.1- Catch Basin Type F Inlet Opening Capacity Calculator**

Using V-Notch Weir Formula equation (6-9)  $Q=2.5\tan(\theta/2)(H^{2.5})$  [San Diego County Drainage Design Manual], where  $\theta=127^\circ$ .

Depth (ft)	H (ft)	Q (cfs)	Q x 2 Inlets
0.9	0.067	0.01	0.01
1	0.167	0.06	0.11
1.1	0.267	0.18	0.37
1.2	0.367	0.41	0.81
1.3	0.467	0.74	1.48
1.4	0.567	1.21	2.41
1.5	0.667	1.81	3.62

**Table 2.2- Flow Through Engineered Soil Layer,  $Q=KIA$**

$A_{\text{BASIN A}} \text{ (sf)} = 8662$   $K \text{ (in/hr)} = 5$

$A_{\text{BASIN B}} \text{ (sf)} = 4286$

Depth (ft)	I, Hydraulic Gradient	Q <sub>BASIN A</sub> (cfs)	Q <sub>BASIN B</sub> (cfs)
0.0	1.000	1.003	0.496
0.1	1.060	1.063	0.526
0.2	1.120	1.123	0.556
0.3	1.180	1.183	0.585
0.4	1.240	1.243	0.615
0.5	1.300	1.303	0.645
0.6	1.360	1.363	0.675
0.7	1.420	1.424	0.704
0.8	1.480	1.484	0.734
0.9	1.540	1.544	0.764
1.0	1.600	1.604	0.794



1.1	1.660	1.664	0.823
1.2	1.720	1.724	0.853
1.3	1.780	1.785	0.883
1.4	1.840	1.845	0.913
1.5	1.900	1.905	0.943

**Table 2.3- Flow of 1"-dia Drain Down Orifice at Base of V2 Storage Layer (TYP of 2)**

Basin Depth	Orifice Area (sf)	Head (ft)	Coefficient	Q discharge (cfs)
0.1	0.00545	2.6	0.603	0.043
0.2	0.00545	2.7	0.603	0.043
0.3	0.00545	2.8	0.603	0.044
0.4	0.00545	2.9	0.603	0.045
0.5	0.00545	3	0.603	0.046
0.6	0.00545	3.1	0.603	0.046
0.7	0.00545	3.2	0.603	0.047
0.8	0.00545	3.3	0.603	0.048
0.9	0.00545	3.4	0.603	0.049
1	0.00545	3.5	0.603	0.049
1.1	0.00545	3.6	0.603	0.050
1.2	0.00545	3.7	0.603	0.051
1.3	0.00545	3.8	0.603	0.051
1.4	0.00545	3.9	0.603	0.052
1.5	0.00545	4	0.603	0.053

**Table 2.4- Basin Outflow and Storage Capacity Calculations**

Basin A- Bottom Basin Area (sf) = 8662

Elev	Depth	Vlume acre-ft	Outflow	Volume CF
374	0	0.124	0	5412.88
374.1	0.1	0.144	1.11	6275.20
374.2	0.2	0.164	1.17	7129.76
374.3	0.3	0.183	1.23	7976.56
374.4	0.4	0.202	1.29	8815.60
374.5	0.5	0.221	1.35	9646.88
374.6	0.6	0.240	1.41	10470.40
374.7	0.7	0.259	1.47	11286.16
374.8	0.8	0.278	1.53	12094.16
374.9	0.9	0.296	1.60	12894.40
375	1	0.314	1.77	13686.88

375.1	1.1	0.332	2.08	14471.60
375.2	1.2	0.350	2.59	15248.56
375.3	1.3	0.368	3.32	16017.76
375.4	1.4	0.385	4.31	16779.20
375.5	1.5	0.402	5.58	17532.88

Basin B- Bottom Basin Area (sf) = 4286

Elev	Depth	Vlume acre-ft	Outflow	Volume CF
416	0	0.061	0	2678.32
416.1	0.1	0.071	0.57	3103.38
416.2	0.2	0.081	0.60	3521.36
416.3	0.3	0.090	0.63	3932.26
416.4	0.4	0.100	0.66	4336.08
416.5	0.5	0.109	0.69	4732.82
416.6	0.6	0.118	0.72	5122.48
416.7	0.7	0.126	0.75	5505.06
416.8	0.8	0.135	0.78	5880.56
416.9	0.9	0.143	0.82	6248.98
417	1	0.152	0.96	6610.32
417.1	1.1	0.160	1.24	6964.58
417.2	1.2	0.168	1.72	7311.76
417.3	1.3	0.176	2.42	7651.86
417.4	1.4	0.183	3.38	7984.88
417.5	1.5	0.191	4.62	8310.82

### **Table 2.5- Drawdown Calculations**

Using Darcy's Law to calculate time required to drain 10" of pond depth in largest basin:

8662	Basin Bottom Area (sf):
12894	Basin Volume @ 10" Depth (cf):
1.66	Depth of Engineered Soil above Outlet Point (ft):
5	Assumed Soil Hydraulic Conductivity in Engineered Soil (in/hr):

$Q = KIA$ ; where  $I$  = Hydraulic Gradient above outlet point

1.51	Q at outlet point (cfs)
2.38	Drawdown Time (hrs) < 72 hrs

✓

## Storage Basin Hydrograph Routing Models

\*\*\*\*\*

### HYDRAULICS ELEMENTS - II PROGRAM PACKAGE

#### STORAGE BASIN HYDROGRAPH ROUTING MODEL

\*\*\*\*\*

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Ver. 19.0 Release Date: 06/01/2012 License ID 1459

Analysis prepared by:

BHA Inc  
5115 Avenida Encinas, Suite L  
Carlsbad CA 92008

#### \*\*\*\*\* DESCRIPTION OF STUDY \*\*\*\*\*

\* Bioretention Basin A Detention Analysis \*  
\* 100 Year Storm Event \*  
\* \*

\*\*\*\*\*

FILE NAME: 1049DTA.DAT

TIME/DATE OF STUDY: 10:25 01/22/2013

#### =====

ENTERED INFORMATION:

-----  
TOTAL NUMBER OF INFLOW HYDROGRAPH INTERVALS = 11  
CONSTANT HYDROGRAPH TIME UNIT(MINUTES) = 15.000  
ASSUMED INITIAL DEPTH(FEET) IN STORAGE BASIN = 0.00  
-----

#### ENTERED INFLOW HYDROGRAPH ORDINATES(CFS):

*INTERVAL	FLOW	*INTERVAL	FLOW	*INTERVAL	FLOW	*
* NUMBER	(CFS)	* NUMBER	(CFS)	* NUMBER	(CFS)	*
* 1:	0.00*	2:	0.80*	3:	0.90*	
* 4:	1.10*	5:	1.30*	6:	1.90*	
* 7:	2.10*	8:	9.98*	9:	1.50*	
* 10:	1.00*	11:	0.00*			

#### =====

DEPTH-VS.-STORAGE AND DEPTH-VS.-DISCHARGE INFORMATION:

-----  
TOTAL NUMBER OF BASIN DEPTH INFORMATION ENTRIES = 16  
-----

*BASIN-DEPTH	STORAGE	OUTFLOW	**BASIN-DEPTH	STORAGE	OUTFLOW	*
* (FEET)	(ACRE-FOET)	(CFS)	** (FEET)	(ACRE-FOET)	(CFS)	*
* 0.000	0.000	0.000**	0.100	0.144	1.110*	
* 0.200	0.164	1.170**	0.300	0.183	1.230*	
* 0.400	0.202	1.290**	0.500	0.221	1.350*	
* 0.600	0.240	1.410**	0.700	0.259	1.470*	
* 0.800	0.278	1.530**	0.900	0.296	1.600*	
* 1.000	0.314	1.770**	1.100	0.332	2.080*	
* 1.200	0.350	2.590**	1.300	0.368	3.320*	
* 1.400	0.385	4.310**	1.500	0.402	5.580*	

\*\*\*\*\*

-----  
 INITIAL BASIN DEPTH (FEET) = 0.00  
 INITIAL BASIN STORAGE (ACRE-FEET) = 0.00  
 INITIAL BASIN OUTFLOW (CFS) = 0.00  
 -----

BASIN STORAGE, OUTFLOW AND DEPTH ROUTING VALUES:

INTERVAL NUMBER	{S-O*DT/2} (ACRE-FEET)	{S+O*DT/2} (ACRE-FEET)
1	0.00000	0.00000
2	0.13253	0.15547
3	0.15191	0.17609
4	0.17029	0.19571
5	0.18867	0.21533
6	0.20705	0.23495
7	0.22543	0.25457
8	0.24381	0.27419
9	0.26219	0.29381
10	0.27947	0.31253
11	0.29571	0.33229
12	0.31051	0.35349
13	0.32324	0.37676
14	0.33370	0.40230
15	0.34048	0.42952
16	0.34436	0.45964

WHERE S=STORAGE (AF) ;O=OUTFLOW (AF/MIN.) ;DT=UNIT (MIN.)

-----  
 \*UNIT-HYDROGRAPH STORAGE-BASIN ROUTING\*

NOTE: COMPUTED BASIN DEPTH, OUTFLOW, AND STORAGE QUANTITIES  
 OCCUR AT THE GIVEN TIME. BASIN INFLOW VALUES REPRESENT THE  
 AVERAGE INFLOW DURING THE RECENT HYDROGRAPH UNIT INTERVAL.

GRAPH NOTATION: "I"=MEAN UNIT INFLOW; "O"=OUTFLOW AT GIVEN TIME

TIME (HOURS)	INFLOW (CFS)	OUTFLOW (CFS)	STORAGE (ACRE-FT)	0.	2.	5.	7.	10.
0.25	0.00	0.00	0.000	O	.	.	.	.
[BASIN DEPTH (FEET) =			0.00]					
0.50	0.80	0.12	0.015	O I	.	.	.	.
[BASIN DEPTH (FEET) =			0.01]					
0.75	0.90	0.23	0.030	O I	.	.	.	.
[BASIN DEPTH (FEET) =			0.02]					
1.00	1.10	0.36	0.047	.O I	.	.	.	.
[BASIN DEPTH (FEET) =			0.03]					
1.25	1.30	0.50	0.065	.O I	.	.	.	.
[BASIN DEPTH (FEET) =			0.05]					
1.50	1.90	0.71	0.092	. O I	.	.	.	.
[BASIN DEPTH (FEET) =			0.06]					
1.75	2.10	0.91	0.118	. O I	.	.	.	.
[BASIN DEPTH (FEET) =			0.08]					
2.00	9.98	1.62	0.298	. O	.	.	.	I
[BASIN DEPTH (FEET) =			0.91]					
2.25	1.50	1.60	0.296	. IO	.	.	.	.

	[BASIN DEPTH (FEET) =	0.90]						
2.50	1.00	1.55	0.284	.	10	.	.	.
	[BASIN DEPTH (FEET) =	0.83]						
2.75	0.00	1.45	0.253	I	O	.	.	.
	[BASIN DEPTH (FEET) =	0.67]						
3.00	0.00	1.36	0.224	I	O	.	.	.
	[BASIN DEPTH (FEET) =	0.52]						
3.25	0.00	1.27	0.197	I	O	.	.	.
	[BASIN DEPTH (FEET) =	0.37]						
3.50	0.00	1.19	0.171	I	O	.	.	.

\*\*\*\*\*  
HYDRAULICS ELEMENTS - II PROGRAM PACKAGE

STORAGE BASIN HYDROGRAPH ROUTING MODEL  
\*\*\*\*\*

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Ver. 19.0 Release Date: 06/01/2012 License ID 1459

Analysis prepared by:

BHA Inc  
5115 Avenida Encinas, Suite L  
Carlsbad CA 92008

\*\*\*\*\* DESCRIPTION OF STUDY \*\*\*\*\*  
\* Bioretention Basin B Detention Analysis \*  
\* 100 Year Storm Event \*  
\* \*  
\*\*\*\*\*

FILE NAME: 1049DTB.DAT  
TIME/DATE OF STUDY: 13:37 01/22/2013

=====

ENTERED INFORMATION:

-----

TOTAL NUMBER OF INFLOW HYDROGRAPH INTERVALS = 14  
CONSTANT HYDROGRAPH TIME UNIT (MINUTES) = 15.000  
ASSUMED INITIAL DEPTH (FEET) IN STORAGE BASIN = 0.00

-----

ENTERED INFLOW HYDROGRAPH ORDINATES (CFS):

*INTERVAL * NUMBER	FLOW (CFS)	*INTERVAL * NUMBER	FLOW (CFS)	*INTERVAL * NUMBER	FLOW (CFS)	*
* 1:	0.00*	2:	0.40*	3:	0.50*	*
* 4:	0.50*	5:	0.60*	6:	0.70*	*
* 7:	0.80*	8:	1.20*	9:	1.60*	*
* 10:	6.15*	11:	1.00*	12:	0.60*	*
* 13:	0.50*	14:	0.00*			

=====

DEPTH-VS.-STORAGE AND DEPTH-VS.-DISCHARGE INFORMATION:

-----

TOTAL NUMBER OF BASIN DEPTH INFORMATION ENTRIES = 16

*BASIN-DEPTH * (FEET)	STORAGE (ACRE-FEET)	OUTFLOW (CFS)	**BASIN-DEPTH ** (FEET)	STORAGE (ACRE-FEET)	OUTFLOW (CFS)	*
* 0.000	0.000	0.000**	0.100	0.071	0.570*	*
* 0.200	0.081	0.600**	0.300	0.090	0.630*	*
* 0.400	0.100	0.660**	0.500	0.109	0.690*	*
* 0.600	0.118	0.720**	0.700	0.126	0.750*	*
* 0.800	0.135	0.780**	0.900	0.143	0.820*	*
* 1.000	0.152	0.960**	1.100	0.160	1.240*	*
* 1.200	0.168	1.720**	1.300	0.176	2.420*	*
* 1.400	0.183	3.380**	1.500	0.191	4.620*	*

\*\*\*\*\*

```

-----
INITIAL BASIN DEPTH (FEET) =      0.00
INITIAL BASIN STORAGE (ACRE-FEET) =      0.00
INITIAL BASIN OUTFLOW (CFS) =      0.00
-----

```

BASIN STORAGE, OUTFLOW AND DEPTH ROUTING VALUES:

INTERVAL NUMBER	{S-O*DT/2} (ACRE-FEET)	{S+O*DT/2} (ACRE-FEET)
1	0.00000	0.00000
2	0.06511	0.07689
3	0.07480	0.08720
4	0.08349	0.09651
5	0.09318	0.10682
6	0.10187	0.11613
7	0.11056	0.12544
8	0.11825	0.13375
9	0.12694	0.14306
10	0.13453	0.15147
11	0.14208	0.16192
12	0.14719	0.17281
13	0.15023	0.18577
14	0.15100	0.20100
15	0.14808	0.21792
16	0.14327	0.23873

WHERE S=STORAGE (AF) ;O=OUTFLOW (AF/MIN.) ;DT=UNIT (MIN.)

\*UNIT-HYDROGRAPH STORAGE-BASIN ROUTING\*

NOTE: COMPUTED BASIN DEPTH, OUTFLOW, AND STORAGE QUANTITIES  
OCCUR AT THE GIVEN TIME. BASIN INFLOW VALUES REPRESENT THE  
AVERAGE INFLOW DURING THE RECENT HYDROGRAPH UNIT INTERVAL.

GRAPH NOTATION: "I"=MEAN UNIT INFLOW; "O"=OUTFLOW AT GIVEN TIME

TIME (HOURS)	INFLOW (CFS)	OUTFLOW (CFS)	STORAGE (ACRE-FT)	0.	2.	3.	5.	6.
0.25	0.00	0.00	0.000	O	.	.	.	.
	[BASIN DEPTH (FEET) = 0.00]							
0.50	0.40	0.06	0.008	O I	.	.	.	.
	[BASIN DEPTH (FEET) = 0.01]							
0.75	0.50	0.13	0.016	O I	.	.	.	.
	[BASIN DEPTH (FEET) = 0.02]							
1.00	0.50	0.19	0.023	O I	.	.	.	.
	[BASIN DEPTH (FEET) = 0.03]							
1.25	0.60	0.25	0.031	.O I	.	.	.	.
	[BASIN DEPTH (FEET) = 0.04]							
1.50	0.70	0.32	0.040	.O I	.	.	.	.
	[BASIN DEPTH (FEET) = 0.06]							
1.75	0.80	0.39	0.049	. O I	.	.	.	.
	[BASIN DEPTH (FEET) = 0.07]							
2.00	1.20	0.52	0.064	. O I	.	.	.	.
	[BASIN DEPTH (FEET) = 0.09]							
2.25	1.60	0.62	0.086	. O I	.	.	.	.

	[BASIN DEPTH (FEET) =	0.25]						
2.50	6.15	2.72	0.178	.	.	0	.	I
	[BASIN DEPTH (FEET) =	1.33]						
2.75	1.00	1.19	0.158	.	IO	.	.	.
	[BASIN DEPTH (FEET) =	1.08]						
3.00	0.60	0.92	0.149	.	IO	.	.	.
	[BASIN DEPTH (FEET) =	0.97]						
3.25	0.50	0.81	0.142	.	I O	.	.	.
	[BASIN DEPTH (FEET) =	0.88]						
3.50	0.00	0.75	0.125	I	O	.	.	.
	[BASIN DEPTH (FEET) =	0.69]						
3.75	0.00	0.70	0.111	I	O	.	.	.
	[BASIN DEPTH (FEET) =	0.52]						



## E. HYDRAULIC ELEMENTS CALCULATIONS

\*\*\*\*\*

HYDRAULIC ELEMENTS - I PROGRAM PACKAGE  
(C) Copyright 1982-2012 Advanced Engineering Software (aes)  
Ver. 19.0 Release Date: 06/01/2012 License ID 1459

Analysis prepared by:

BHA Inc  
5115 Avenida Encinas, Suite L  
Carlsbad CA 92008

-----  
TIME/DATE OF STUDY: 11:08 01/22/2013  
=====

### NODE 105:

Problem Descriptions:

Node 105- Type B Curb Inlet Capacity

\*\*\*\*\*

>>>>STREETFLOW MODEL INPUT INFORMATION<<<<

-----  
CONSTANT STREET GRADE(FEET/FEET) = 0.060200  
CONSTANT STREET FLOW(CFS) = 5.16  
AVERAGE STREETFLOW FRICTION FACTOR(MANNING) = 0.013000  
CONSTANT SYMMETRICAL STREET HALF-WIDTH(FEET) = 16.00  
DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) = 10.00  
INTERIOR STREET CROSSFALL(DECIMAL) = 0.020000  
OUTSIDE STREET CROSSFALL(DECIMAL) = 0.020000  
CONSTANT SYMMETRICAL CURB HEIGHT(FEET) = 0.50  
CONSTANT SYMMETRICAL GUTTER-WIDTH(FEET) = 1.50  
CONSTANT SYMMETRICAL GUTTER-LIP(FEET) = 0.03125  
CONSTANT SYMMETRICAL GUTTER-HIKE(FEET) = 0.12500  
FLOW ASSUMED TO FILL STREET ON ONE SIDE, AND THEN SPLITS  
=====

STREET FLOW MODEL RESULTS:

-----  
STREET FLOW DEPTH(FEET) = 0.29  
HALFSTREET FLOOD WIDTH(FEET) = 8.30  
AVERAGE FLOW VELOCITY(FEET/SEC.) = 6.40  
PRODUCT OF DEPTH&VELOCITY = 1.87

\*\*\*\*\*

>>>>FLOWBY CATCH BASIN INLET CAPACITY INPUT INFORMATION<<<<

-----  
Curb Inlet Capacities are approximated based on the Bureau of  
Public Roads nomograph plots for flowby basins and sump basins.

STREETFLOW(CFS) = 5.16  
GUTTER FLOWDEPTH(FEET) = 0.29  
BASIN LOCAL DEPRESSION(FEET) = 0.33

-----  
FLOWBY BASIN ANALYSIS RESULTS:

BASIN WIDTH	FLOW INTERCEPTION
1.89	0.72
2.00	0.75
2.50	0.94
3.00	1.12
3.50	1.29
4.00	1.47
4.50	1.65
5.00	1.82
5.50	2.00
6.00	2.17
6.50	2.35
7.00	2.50
7.50	2.65
8.00	2.79
8.50	2.93
9.00	3.06
9.50	3.20
10.00	3.33
10.50	3.46
11.00	3.60
11.50	3.72
12.00	3.82
12.50	3.93
13.00	4.03
13.50	4.13
14.00	4.23
14.50	4.33
15.00	4.43
15.50	4.53
16.00	4.62
16.50	4.72
17.00	4.81
17.50	4.90
18.00	4.99
18.50	5.08
18.92	5.16

=====

**NODE 120:**

Problem Descriptions:

Node 120- Type B Curb Inlet Capacity

\*\*\*\*\*  
>>>>STREETFLOW MODEL INPUT INFORMATION<<<<

-----  
CONSTANT STREET GRADE (FEET/FEET) = 0.060200  
CONSTANT STREET FLOW (CFS) = 3.37  
AVERAGE STREETFLOW FRICTION FACTOR (MANNING) = 0.013000  
CONSTANT SYMMETRICAL STREET HALF-WIDTH (FEET) = 16.00  
DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK (FEET) = 10.00  
INTERIOR STREET CROSSFALL (DECIMAL) = 0.020000  
OUTSIDE STREET CROSSFALL (DECIMAL) = 0.020000

CONSTANT SYMMETRICAL CURB HEIGHT (FEET) = 0.50  
CONSTANT SYMMETRICAL GUTTER-WIDTH (FEET) = 1.50  
CONSTANT SYMMETRICAL GUTTER-LIP (FEET) = 0.03125  
CONSTANT SYMMETRICAL GUTTER-HIKE (FEET) = 0.12500  
FLOW ASSUMED TO FILL STREET ON ONE SIDE, AND THEN SPLITS

---

STREET FLOW MODEL RESULTS:

---

STREET FLOW DEPTH (FEET) = 0.27  
HALFSTREET FLOOD WIDTH (FEET) = 7.39  
AVERAGE FLOW VELOCITY (FEET/SEC.) = 5.07  
PRODUCT OF DEPTH&VELOCITY = 1.39

\*\*\*\*\*  
>>>>SUMP TYPE BASIN INPUT INFORMATION<<<<

---

Curb Inlet Capacities are approximated based on the Bureau of  
Public Roads nomograph plots for flowby basins and sump basins.

BASIN INFLOW (CFS) = 3.37  
BASIN OPENING (FEET) = 0.50  
DEPTH OF WATER (FEET) = 0.83

>>>>CALCULATED ESTIMATED SUMP BASIN WIDTH (FEET) = 1.81

---

**NODE 255:**

Problem Descriptions:

Node 255- Type B Curb Inlet Capacity

\*\*\*\*\*  
>>>>STREETFLOW MODEL INPUT INFORMATION<<<<

---

CONSTANT STREET GRADE (FEET/FEET) = 0.070000  
CONSTANT STREET FLOW (CFS) = 6.07  
AVERAGE STREETFLOW FRICTION FACTOR (MANNING) = 0.013000  
CONSTANT SYMMETRICAL STREET HALF-WIDTH (FEET) = 16.00  
DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK (FEET) = 10.00  
INTERIOR STREET CROSSFALL (DECIMAL) = 0.020000  
OUTSIDE STREET CROSSFALL (DECIMAL) = 0.020000  
CONSTANT SYMMETRICAL CURB HEIGHT (FEET) = 0.50  
CONSTANT SYMMETRICAL GUTTER-WIDTH (FEET) = 1.50  
CONSTANT SYMMETRICAL GUTTER-LIP (FEET) = 0.03125  
CONSTANT SYMMETRICAL GUTTER-HIKE (FEET) = 0.12500  
FLOW ASSUMED TO FILL STREET ON ONE SIDE, AND THEN SPLITS

---

STREET FLOW MODEL RESULTS:

---

STREET FLOW DEPTH (FEET) = 0.31  
HALFSTREET FLOOD WIDTH (FEET) = 9.20  
AVERAGE FLOW VELOCITY (FEET/SEC.) = 6.29  
PRODUCT OF DEPTH&VELOCITY = 1.95

\*\*\*\*\*  
>>>>FLOWBY CATCH BASIN INLET CAPACITY INPUT INFORMATION<<<<

---

Curb Inlet Capacities are approximated based on the Bureau of  
Public Roads nomograph plots for flowby basins and sump basins.

STREETFLOW (CFS) = 6.07  
GUTTER FLOWDEPTH (FEET) = 0.31  
BASIN LOCAL DEPRESSION (FEET) = 0.33

---

FLOWBY BASIN ANALYSIS RESULTS:

BASIN WIDTH	FLOW INTERCEPTION
2.07	0.85
2.50	1.02
3.00	1.21
3.50	1.40
4.00	1.60
4.50	1.79
5.00	1.98
5.50	2.17
6.00	2.36
6.50	2.55
7.00	2.74
7.50	2.91
8.00	3.06
8.50	3.22
9.00	3.36
9.50	3.51
10.00	3.66
10.50	3.80
11.00	3.95
11.50	4.09
12.00	4.23
12.50	4.37
13.00	4.48
13.50	4.59
14.00	4.70
14.50	4.81
15.00	4.92
15.50	5.02
16.00	5.13
16.50	5.23
17.00	5.33
17.50	5.43
18.00	5.54
18.50	5.63
19.00	5.73
19.50	5.83
20.00	5.93
20.50	6.02
20.74	6.07

---

**RIP RAP ENERGY DISSIPATOR TABLE (PER D-40):**

<b>Node</b>	<b>Q100</b>	<b>V100</b>	<b>Rock Classification</b>	<b>T (min)</b>
103	6.33	5.59	No. 2 Backing	1.1 feet
130	3.67	7.84	No. 2 Backing	1.1 feet
250	6.07	9.18	No. 2 Backing	1.1 feet
252	6.07	7.35	No. 2 Backing*	1.1 feet*
254	6.15	8.75	No. 2 Backing	1.1 feet

\*Grouted

F. GAMBONI RANCH HYDROLOGY REPORT CALCULATION  
REFERENCES AND MAP

2            2.89        28.31            2.583            2.20

RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO  
CONFLUENCE FORMULA USED FOR 2 STREAMS.

\*\* PEAK FLOW RATE TABLE \*\*

STREAM NUMBER	RUNOFF (CFS)	Tc (MIN.)	INTENSITY (INCH/HOUR)
1	8.66	15.40	3.825
2	7.42	28.31	2.583

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:

PEAK FLOW RATE(CFS) =        8.66    Tc(MIN.) =    15.40  
TOTAL AREA(ACRES) =        5.60

\*\*\*\*\*  
FLOW PROCESS FROM NODE    320.00 TO NODE    320.00 IS CODE =    11

-----  
>>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<  
=====

\*\* MAIN STREAM CONFLUENCE DATA \*\*

STREAM NUMBER	RUNOFF (CFS)	Tc (MIN.)	INTENSITY (INCH/HOUR)	AREA (ACRE)
1	8.66	15.40	3.825	5.60

\*\* MEMORY BANK # 1 CONFLUENCE DATA \*\*

STREAM NUMBER	RUNOFF (CFS)	Tc (MIN.)	INTENSITY (INCH/HOUR)	AREA (ACRE)
1	16.38	17.81	3.483	10.60

\*\* PEAK FLOW RATE TABLE \*\*

STREAM NUMBER	RUNOFF (CFS)	Tc (MIN.)	INTENSITY (INCH/HOUR)
1	23.57	15.40	3.825
2	24.26	17.81	3.483

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:

PEAK FLOW RATE(CFS) =        24.26    Tc(MIN.) =    17.81  
TOTAL AREA(ACRES) =        16.20

\*\*\*\*\*  
FLOW PROCESS FROM NODE    320.00 TO NODE    320.00 IS CODE =    12

-----  
>>>>>CLEAR MEMORY BANK # 1 <<<<<  
=====

\*\*\*\*\*  
FLOW PROCESS FROM NODE    320.00 TO NODE    320.10 IS CODE =    4

-----  
>>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<  
>>>>>USING USER-SPECIFIED PIPESIZE<<<<<  
=====

DEPTH OF FLOW IN    24.0 INCH PIPE IS    16.2 INCHES



PIPEFLOW VELOCITY(FEET/SEC.) = 10.7  
 UPSTREAM NODE ELEVATION = 458.37  
 DOWNSTREAM NODE ELEVATION = 454.50  
 FLOWLENGTH(FEET) = 193.87 MANNING'S N = .013  
 GIVEN PIPE DIAMETER(INCH) = 24.00 NUMBER OF PIPES = 1  
 PIPEFLOW THRU SUBAREA(CFS) = 24.26  
 TRAVEL TIME(MIN.) = .30 TC(MIN.) = 18.12

\*\*\*\*\*  
 FLOW PROCESS FROM NODE 320.10 TO NODE 360.00 IS CODE = 51  
 -----

>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<  
 >>>>TRAVELTIME THRU SUBAREA<<<<

=====  
 UPSTREAM NODE ELEVATION = 454.50  
 DOWNSTREAM NODE ELEVATION = 431.00  
 CHANNEL LENGTH THRU SUBAREA(FEET) = 420.00  
 CHANNEL SLOPE = .0560  
 CHANNEL BASE(FEET) = 2.00 "Z" FACTOR = 2.000  
 MANNING'S FACTOR = .035 MAXIMUM DEPTH(FEET) = 2.00  
 CHANNEL FLOW THRU SUBAREA(CFS) = 24.26  
 FLOW VELOCITY(FEET/SEC) = 6.95 FLOW DEPTH(FEET) = .91  
 TRAVEL TIME(MIN.) = 1.01 TC(MIN.) = 19.12

\*\*\*\*\*  
 FLOW PROCESS FROM NODE 360.00 TO NODE 360.00 IS CODE = 1  
 -----

>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<

=====  
 TOTAL NUMBER OF STREAMS = 2  
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 1 ARE:  
 TIME OF CONCENTRATION(MIN.) = 19.12  
 RAINFALL INTENSITY(INCH/HR) = 3.33  
 TOTAL STREAM AREA(ACRES) = 16.20  
 PEAK FLOW RATE(CFS) AT CONFLUENCE = 24.26

\*\*\*\*\*  
 FLOW PROCESS FROM NODE 330.00 TO NODE 340.00 IS CODE = 21  
 -----

>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<

=====  
 SOIL CLASSIFICATION IS "C"  
 RURAL DEVELOPMENT RUNOFF COEFFICIENT = .4000  
 NATURAL WATERSHED NOMOGRAPH TIME OF CONCENTRATION (APPENDIX X-A)  
 WITH 10-MINUTES ADDED = 11.68(MINUTES)  
 INITIAL SUBAREA FLOW-LENGTH = 120.00  
 UPSTREAM ELEVATION = 526.50  
 DOWNSTREAM ELEVATION = 525.00  
 ELEVATION DIFFERENCE = 1.50  
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 4.572  
 SUBAREA RUNOFF(CFS) = .37  
 TOTAL AREA(ACRES) = .20 TOTAL RUNOFF(CFS) = .37



UPSTREAM ELEVATION = 508.00  
 DOWNSTREAM ELEVATION = 484.00  
 ELEVATION DIFFERENCE = 24.00  
 URBAN SUBAREA OVERLAND TIME OF FLOW(MINUTES) = 18.044  
 \*CAUTION: SUBAREA SLOPE EXCEEDS COUNTY NOMOGRAPH  
 DEFINITION. EXTRAPOLATION OF NOMOGRAPH USED.  
 \*CAUTION: SUBAREA FLOWLENGTH EXCEEDS COUNTY  
 NOMOGRAPH DEFINITION. EXTRAPOLATION OF NOMOGRAPH USED.  
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 3.454  
 SUBAREA RUNOFF(CFS) = 1.55  
 TOTAL AREA(ACRES) = .90 TOTAL RUNOFF(CFS) = 1.55

\*\*\*\*\*

FLOW PROCESS FROM NODE 380.00 TO NODE 390.00 IS CODE = 6

>>>>COMPUTE STREETFLOW TRAVELTIME THRU SUBAREA<<<<

UPSTREAM ELEVATION = 508.00 DOWNSTREAM ELEVATION = 469.10  
 STREET LENGTH(FEET) = 425.00 CURB HEIGHT(INCHES) = 6.  
 STREET HALFWIDTH(FEET) = 20.00

DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK = 18.50  
 INTERIOR STREET CROSSFALL(DECIMAL) = .020  
 OUTSIDE STREET CROSSFALL(DECIMAL) = .083

SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF = 1

\*\*TRAVELTIME COMPUTED USING MEAN FLOW(CFS) = 2.46

STREETFLOW MODEL RESULTS:

STREET FLOWDEPTH(FEET) = .24  
 HALFSTREET FLOODWIDTH(FEET) = 5.84  
 AVERAGE FLOW VELOCITY(FEET/SEC.) = 5.37  
 PRODUCT OF DEPTH&VELOCITY = 1.30

STREETFLOW TRAVELTIME(MIN) = 1.32 TC(MIN) = 19.36

100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 3.301  
 SOIL CLASSIFICATION IS "C"  
 SINGLE FAMILY DEVELOPMENT RUNOFF COEFFICIENT = .5000  
 SUBAREA AREA(ACRES) = 1.10 SUBAREA RUNOFF(CFS) = 1.82  
 SUMMED AREA(ACRES) = 2.00 TOTAL RUNOFF(CFS) = 3.37  
 END OF SUBAREA STREETFLOW HYDRAULICS:  
 DEPTH(FEET) = .27 HALFSTREET FLOODWIDTH(FEET) = 6.99  
 FLOW VELOCITY(FEET/SEC.) = 5.55 DEPTH\*VELOCITY = 1.48

\*\*\*\*\*

FLOW PROCESS FROM NODE 390.00 TO NODE 400.00 IS CODE = 51

>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<

>>>>TRAVELTIME THRU SUBAREA<<<<

UPSTREAM NODE ELEVATION = 469.10  
 DOWNSTREAM NODE ELEVATION = 419.00  
 CHANNEL LENGTH THRU SUBAREA(FEET) = 104.00  
 CHANNEL SLOPE = .4817  
 CHANNEL BASE(FEET) = 2.00 "Z" FACTOR = 1.500

MANNING'S FACTOR = .015    MAXIMUM DEPTH(FEET) = 1.00  
 CHANNEL FLOW THRU SUBAREA(CFS) = 3.37  
 FLOW VELOCITY(FEET/SEC) = 14.20    FLOW DEPTH(FEET) = .11  
 TRAVEL TIME(MIN.) = .12    TC(MIN.) = 19.49

\*\*\*\*\*

FLOW PROCESS FROM NODE 390.00 TO NODE 400.00 IS CODE = 8

=====  
 >>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<  
 =====

100 YEAR RAINFALL INTENSITY(INCH/HOUR) = 3.287  
 SOIL CLASSIFICATION IS "C"  
 SINGLE FAMILY DEVELOPMENT RUNOFF COEFFICIENT = .5000  
 SUBAREA AREA(ACRES) = .40    SUBAREA RUNOFF(CFS) = .66  
 TOTAL AREA(ACRES) = 2.40    TOTAL RUNOFF(CFS) = 4.03  
 TC(MIN) = 19.49

\*\*\*\*\*

FLOW PROCESS FROM NODE 400.00 TO NODE 400.00 IS CODE = 1

=====  
 >>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<  
 >>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<  
 =====

TOTAL NUMBER OF STREAMS = 2  
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 2 ARE:  
 TIME OF CONCENTRATION(MIN.) = 19.49  
 RAINFALL INTENSITY(INCH/HR) = 3.29  
 TOTAL STREAM AREA(ACRES) = 2.40  
 PEAK FLOW RATE(CFS) AT CONFLUENCE = 4.03

\*\* CONFLUENCE DATA \*\*

STREAM NUMBER	RUNOFF (CFS)	Tc (MIN.)	INTENSITY (INCH/HOUR)	AREA (ACRE)
1	49.24	20.17	3.215	38.30
2	4.03	19.49	3.287	2.40

RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO  
 CONFLUENCE FORMULA USED FOR 2 STREAMS.

\*\* PEAK FLOW RATE TABLE \*\*

STREAM NUMBER	RUNOFF (CFS)	Tc (MIN.)	INTENSITY (INCH/HOUR)
1	52.18	19.49	3.287
2	53.18	20.17	3.215

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:

PEAK FLOW RATE(CFS) = 53.18    Tc(MIN.) = 20.17  
 TOTAL AREA(ACRES) = 40.70

\*\*\*\*\*

FLOW PROCESS FROM NODE 400.00 TO NODE 420.00 IS CODE = 51

=====  
 >>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<  
 >>>>TRAVELTIME THRU SUBAREA<<<<  
 =====

#### **IV. REFERENCES**



# County of San Diego Hydrology Manual



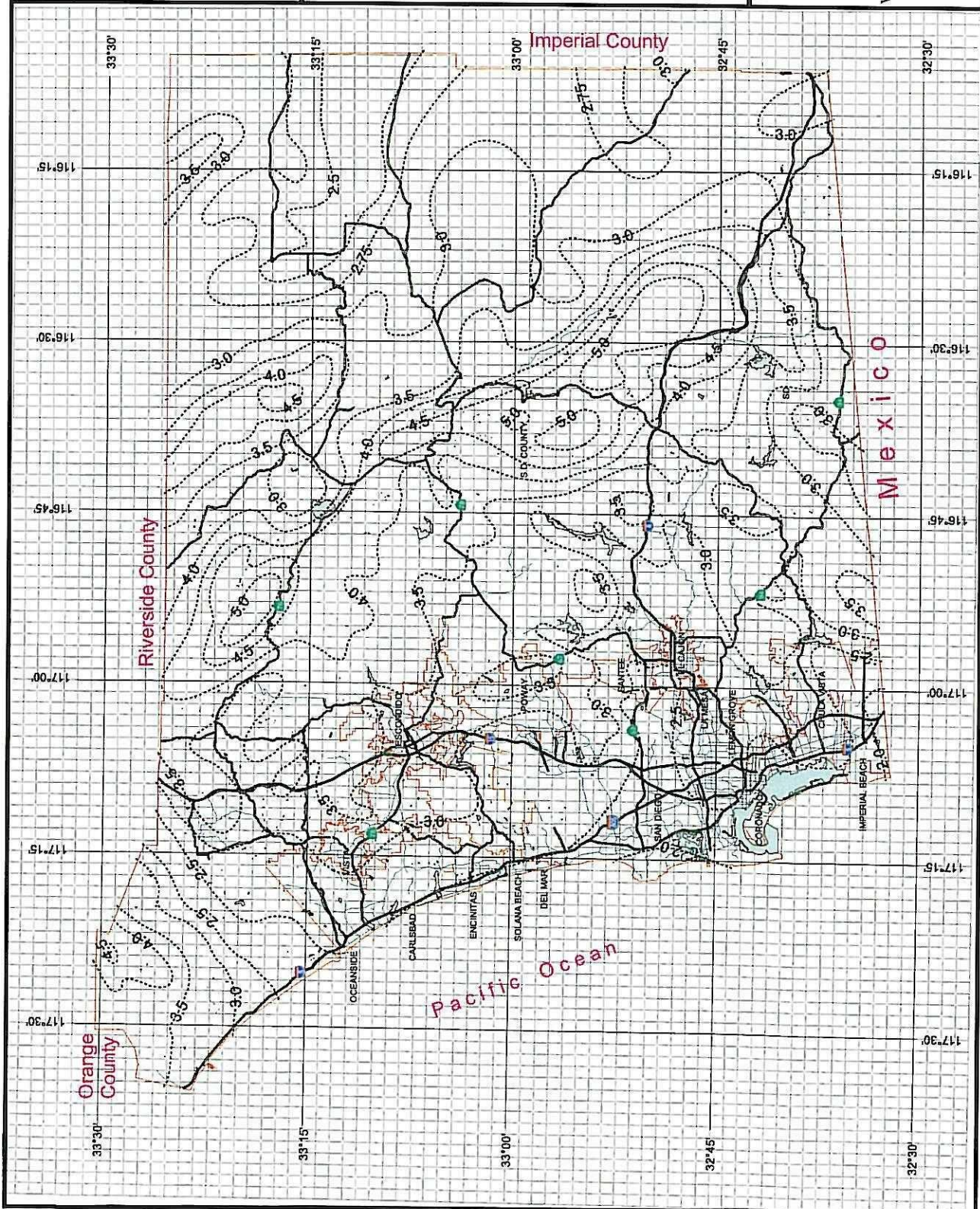
## Rainfall Isoplethals

100 Year Rainfall Event - 6 Hours

..... Isoplethial (inches)



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# County of San Diego Hydrology Manual



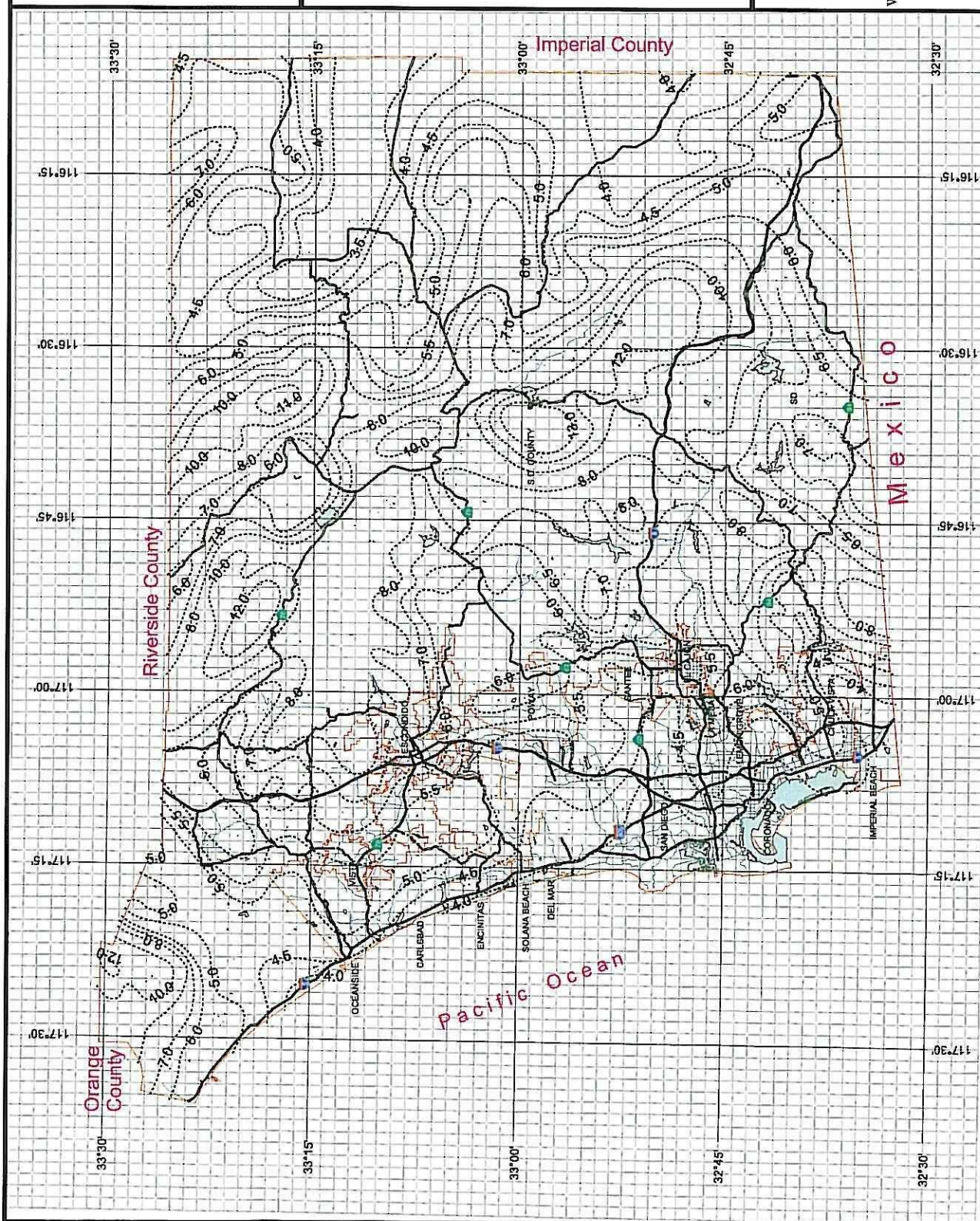
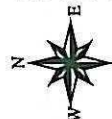
## Rainfall Isopleths

100 Year Rainfall Event - 24 Hours

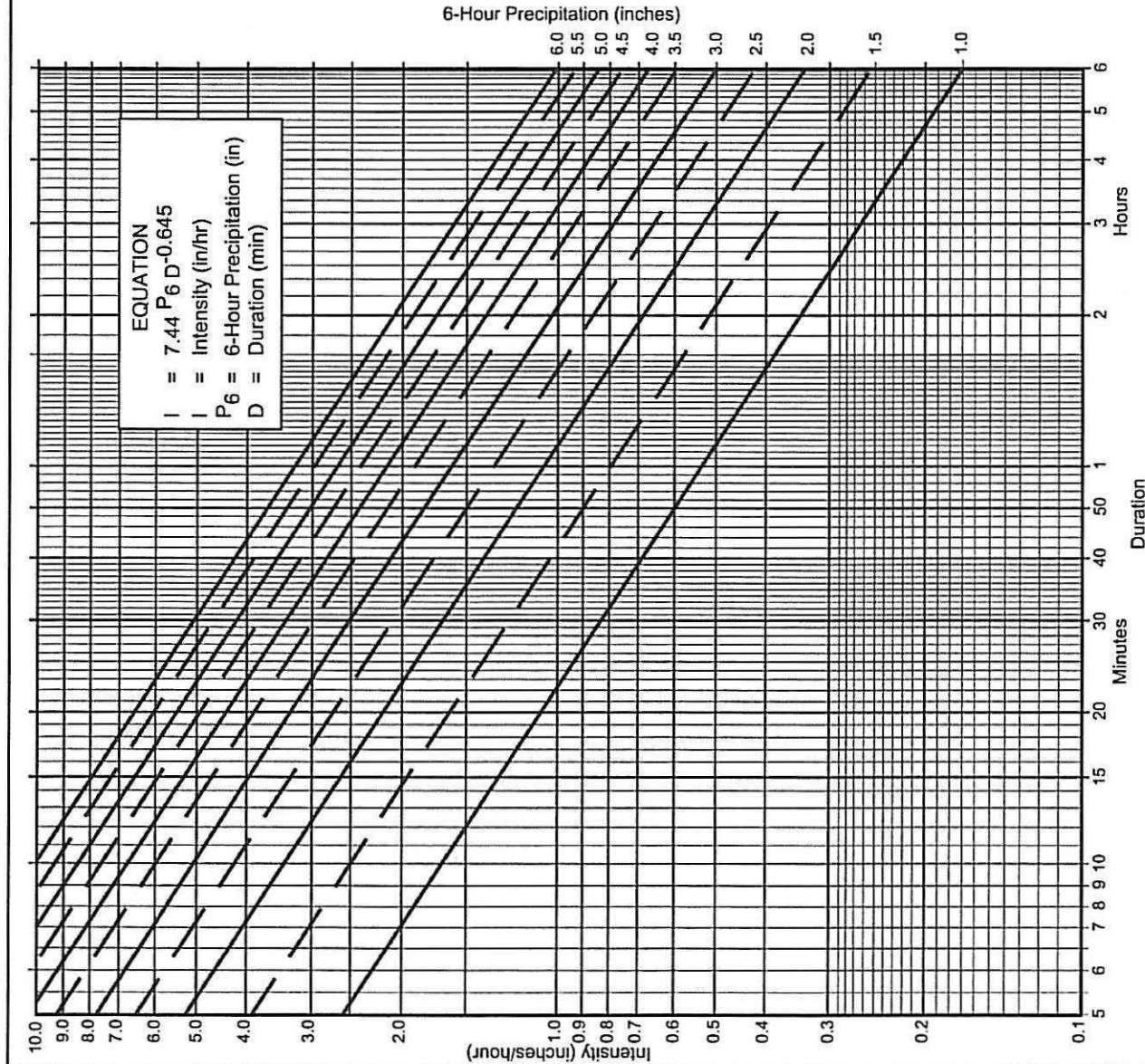
Isopleth (inches)



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### Directions for Application:

- (1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).
- (2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicable to Desert).
- (3) Plot 6 hr precipitation on the right side of the chart.
- (4) Draw a line through the point parallel to the plotted lines.
- (5) This line is the intensity-duration curve for the location being analyzed.

### Application Form:

- (a) Selected frequency \_\_\_\_\_ year
- (b)  $P_6 =$  \_\_\_\_\_ in.,  $P_{24} =$  \_\_\_\_\_,  $\frac{P_6}{P_{24}} =$  \_\_\_\_\_ %<sup>(2)</sup>
- (c) Adjusted  $P_6^{(2)} =$  \_\_\_\_\_ in.
- (d)  $t_x =$  \_\_\_\_\_ min.
- (e)  $I =$  \_\_\_\_\_ in./hr.

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

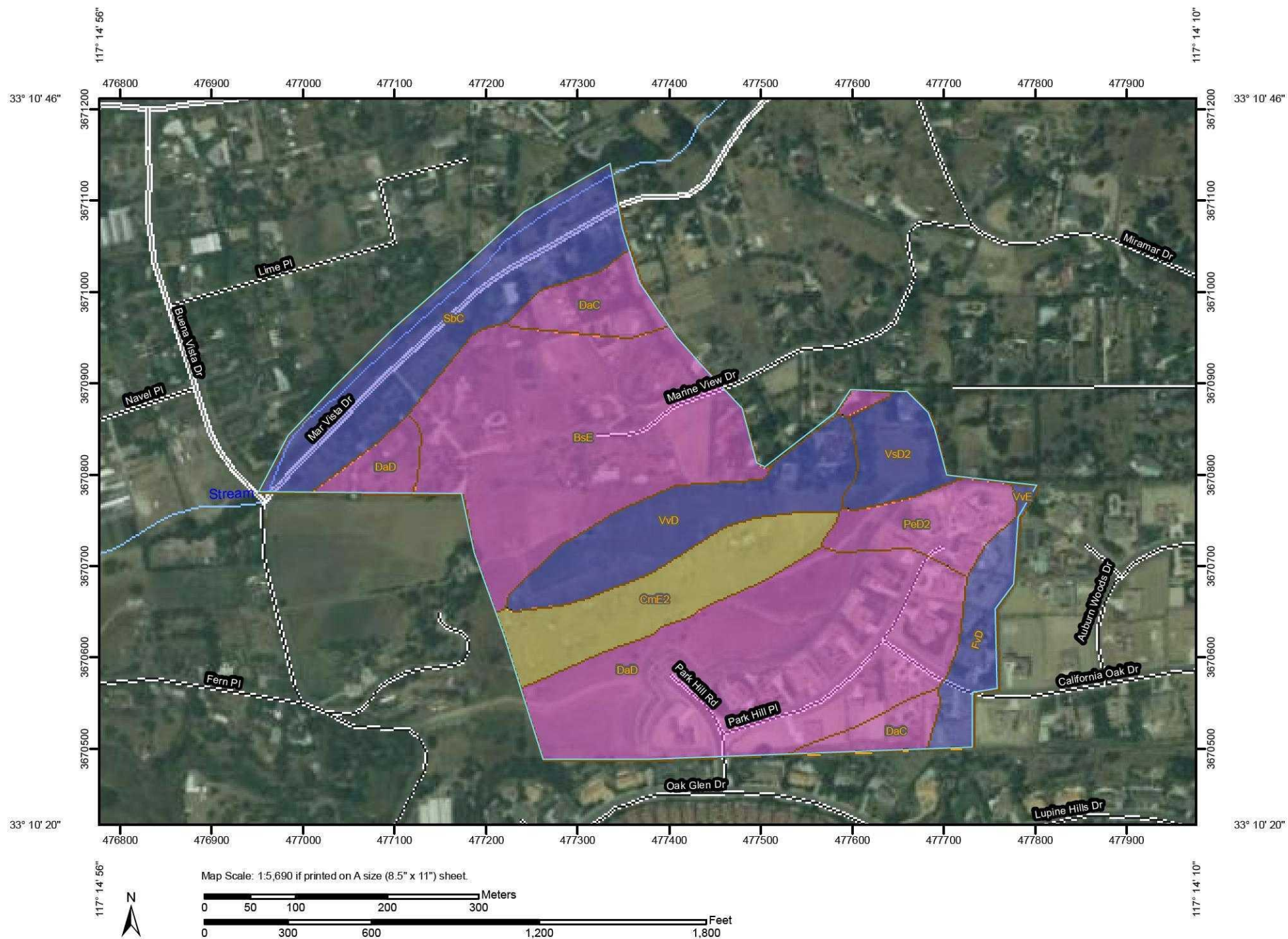
P6	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Duration	I	I	I	I	I	I	I	I	I	I	I
5	2.53	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

FIGURE

3-1

Intensity-Duration Design Chart - Template


# Hydrologic Soil Group—San Diego County Area, California





## MAP LEGEND









### Area of Interest (AOI)

 Area of Interest (AOI)

### Soils

 Soil Map Units


### Soil Ratings

 A  
 A/D  
 B  
 B/D  
 C  
 C/D  
 D  
 Not rated or not available

### Political Features

 Cities

### Water Features

 Streams and Canals

### Transportation

 Rails  
 Interstate Highways  
 US Routes  
 Major Roads  
 Local Roads

## MAP INFORMATION

Map Scale: 1:5,690 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service  
 Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>  
 Coordinate System: UTM Zone 11N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: San Diego County Area, California  
 Survey Area Data: Version 6, Dec 17, 2007

Date(s) aerial images were photographed: 6/7/2005

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.



## Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — San Diego County Area, California (CA638)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
BsE	Bosanko clay, 15 to 30 percent slopes	D	17.3	24.7%
CmE2	Cieneba rocky coarse sandy loam, 9 to 30 percent slopes , eroded	C	5.9	8.5%
DaC	Diablo clay, 2 to 9 percent slopes	D	3.6	5.1%
DaD	Diablo clay, 9 to 15 percent slopes	D	19.4	27.7%
FvD	Fallbrook-Vista sandy loams, 9 to 15 percent slopes	B	2.7	3.8%
PeD2	Placentia sandy loam, 9 to 15 percent slopes, eroded	D	3.2	4.5%
SbC	Salinas clay loam, 2 to 9 percent slopes	B	8.9	12.7%
VsD2	Vista coarse sandy loam, 9 to 15 percent slopes, eroded	B	2.6	3.7%
VvD	Vista rocky coarse sandy loam, 5 to 15 percent slopes	B	6.4	9.1%
VvE	Vista rocky coarse sandy loam, 15 to 30 percent slopes	B	0.1	0.2%
<b>Totals for Area of Interest</b>			<b>70.1</b>	<b>100.0%</b>

## Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

## Rating Options

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff:* None Specified

*Tie-break Rule:* Higher

RUN DATE 1/21/2013  
HYDROGRAPH FILE NAME Text1  
TIME OF CONCENTRATION 41 MIN.  
6 HOUR RAINFALL 3.2 INCHES  
BASIN AREA 8.54 ACRES  
RUNOFF COEFFICIENT 0.511  
PEAK DISCHARGE 9.98 CFS

INFLOW HYDROGRAPH  
BASIN A  
STUDY: 1049DTA

TIME (MIN) = 0	DISCHARGE (CFS) = 0
TIME (MIN) = 41	DISCHARGE (CFS) = 0.8
TIME (MIN) = 82	DISCHARGE (CFS) = 0.9
TIME (MIN) = 123	DISCHARGE (CFS) = 1.1
TIME (MIN) = 164	DISCHARGE (CFS) = 1.3
TIME (MIN) = 205	DISCHARGE (CFS) = 1.9
TIME (MIN) = 246	DISCHARGE (CFS) = 2.1
TIME (MIN) = 287	DISCHARGE (CFS) = 9.98
TIME (MIN) = 328	DISCHARGE (CFS) = 1.5
TIME (MIN) = 369	DISCHARGE (CFS) = 1
TIME (MIN) = 410	DISCHARGE (CFS) = 0

RUN DATE 1/22/2013  
HYDROGRAPH FILE NAME Text1  
TIME OF CONCENTRATION 30 MIN.  
6 HOUR RAINFALL 3.2 INCHES  
BASIN AREA 4.8 ACRES  
RUNOFF COEFFICIENT 0.478  
PEAK DISCHARGE 6.15 CFS

INFLOW HYDROGRAPH  
BASIN B  
STUDY: 1049DTB

TIME (MIN) = 0	DISCHARGE (CFS) = 0
TIME (MIN) = 30	DISCHARGE (CFS) = 0.4
TIME (MIN) = 60	DISCHARGE (CFS) = 0.5
TIME (MIN) = 90	DISCHARGE (CFS) = 0.5
TIME (MIN) = 120	DISCHARGE (CFS) = 0.6
TIME (MIN) = 150	DISCHARGE (CFS) = 0.7
TIME (MIN) = 180	DISCHARGE (CFS) = 0.8
TIME (MIN) = 210	DISCHARGE (CFS) = 1.2
TIME (MIN) = 240	DISCHARGE (CFS) = 1.6
TIME (MIN) = 270	DISCHARGE (CFS) = 6.15
TIME (MIN) = 300	DISCHARGE (CFS) = 1
TIME (MIN) = 330	DISCHARGE (CFS) = 0.6
TIME (MIN) = 360	DISCHARGE (CFS) = 0.5
TIME (MIN) = 390	DISCHARGE (CFS) = 0

Table 3-1  
RUNOFF COEFFICIENTS FOR URBAN AREAS

Land Use		Runoff Coefficient "C"				
NRCS Elements	County Elements	% IMPER.	Soil Type			
			A	B	C	D
Undisturbed Natural Terrain (Natural)	Permanent Open Space	0*	0.20	0.25	0.30	0.35
Low Density Residential (LDR)	Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41
Low Density Residential (LDR)	Residential, 2.0 DU/A or less	20	0.34	0.38	0.42	0.46
Low Density Residential (LDR)	Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49
Medium Density Residential (MDR)	Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52
Medium Density Residential (MDR)	Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	0.57
Medium Density Residential (MDR)	Residential, 10.9 DU/A or less	45	0.52	0.54	0.57	0.60
Medium Density Residential (MDR)	Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63
High Density Residential (HDR)	Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71
High Density Residential (HDR)	Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79
Commercial/Industrial (N. Com)	Neighborhood Commercial	80	0.76	0.77	0.78	0.79
Commercial/Industrial (G. Com)	General Commercial	85	0.80	0.80	0.81	0.82
Commercial/Industrial (O.P. Com)	Office Professional/Commercial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (Limited I.)	Limited Industrial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (General I.)	General Industrial	95	0.87	0.87	0.87	0.87

\*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the pervious runoff coefficient,  $C_p$ , for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).

DU/A = dwelling units per acre

NRCS = National Resources Conservation Service

Note that the Initial Time of Concentration should be reflective of the general land-use at the upstream end of a drainage basin. A single lot with an area of two or less acres does not have a significant effect where the drainage basin area is 20 to 600 acres.

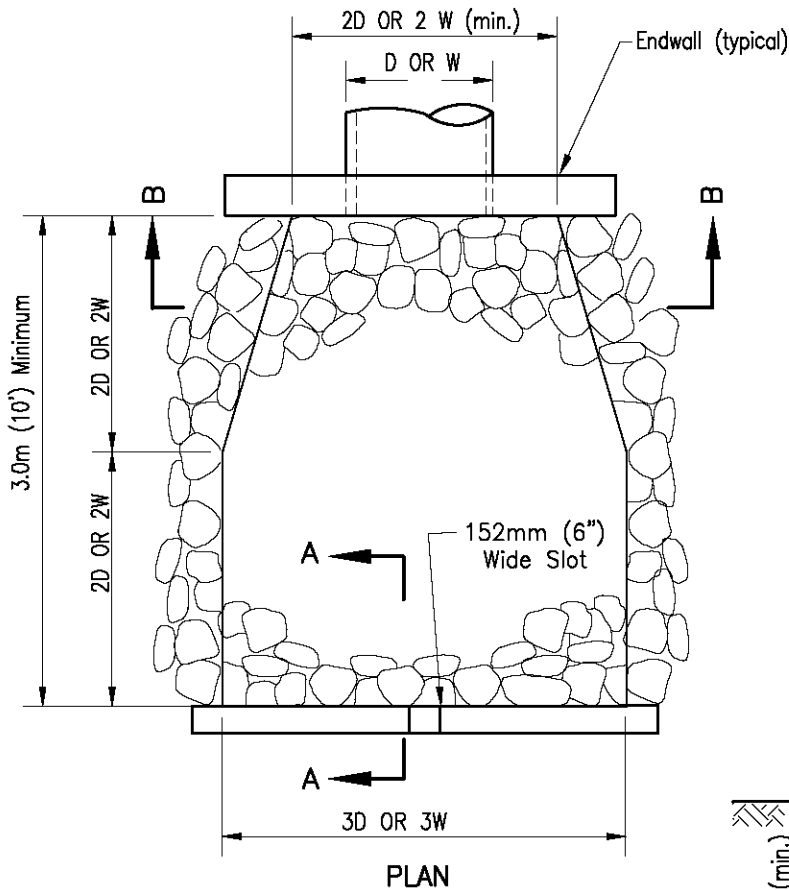
Table 3-2 provides limits of the length (Maximum Length ( $L_M$ )) of sheet flow to be used in hydrology studies. Initial  $T_i$  values based on average C values for the Land Use Element are also included. These values can be used in planning and design applications as described below. Exceptions may be approved by the "Regulating Agency" when submitted with a detailed study.

**Table 3-2**

**MAXIMUM OVERLAND FLOW LENGTH ( $L_M$ )  
& INITIAL TIME OF CONCENTRATION ( $T_i$ )**

Element*	DU/ Acre	.5%		1%		2%		3%		5%		10%	
		$L_M$	$T_i$	$L_M$	$T_i$	$L_M$	$T_i$	$L_M$	$T_i$	$L_M$	$T_i$	$L_M$	$T_i$
Natural		50	13.2	70	12.5	85	10.9	100	10.3	100	8.7	100	6.9
LDR	1	50	12.2	70	11.5	85	10.0	100	9.5	100	8.0	100	6.4
LDR	2	50	11.3	70	10.5	85	9.2	100	8.8	100	7.4	100	5.8
LDR	2.9	50	10.7	70	10.0	85	8.8	95	8.1	100	7.0	100	5.6
MDR	4.3	50	10.2	70	9.6	80	8.1	95	7.8	100	6.7	100	5.3
MDR	7.3	50	9.2	65	8.4	80	7.4	95	7.0	100	6.0	100	4.8
MDR	10.9	50	8.7	65	7.9	80	6.9	90	6.4	100	5.7	100	4.5
MDR	14.5	50	8.2	65	7.4	80	6.5	90	6.0	100	5.4	100	4.3
HDR	24	50	6.7	65	6.1	75	5.1	90	4.9	95	4.3	100	3.5
HDR	43	50	5.3	65	4.7	75	4.0	85	3.8	95	3.4	100	2.7
N. Com		50	5.3	60	4.5	75	4.0	85	3.8	95	3.4	100	2.7
G. Com		50	4.7	60	4.1	75	3.6	85	3.4	90	2.9	100	2.4
O.P./Com		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
Limited I.		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
General I.		50	3.7	60	3.2	70	2.7	80	2.6	90	2.3	100	1.9

\*See Table 3-1 for more detailed description

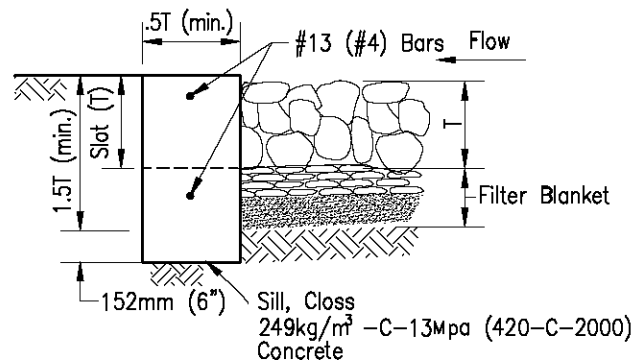


Design Velocity m/sec (ft/sec)*	Rock Classification	T (min)
1.8-3 (6-10)	No. 2 Backing	320mm (1.1ft)
3-3.7 (10-12)	220 kg (1/4 ton)	823mm (2.7ft)
3.7-4.3 (12-14)	450 kg (1/2 ton)	1.1m (3.5ft)
4.3-4.9 (14-16)	900 kg (1 ton)	1.3m (4.4ft)
4.9-5.5 (16-18)	1.8 tonne (2 ton)	1.6m (5.4ft)

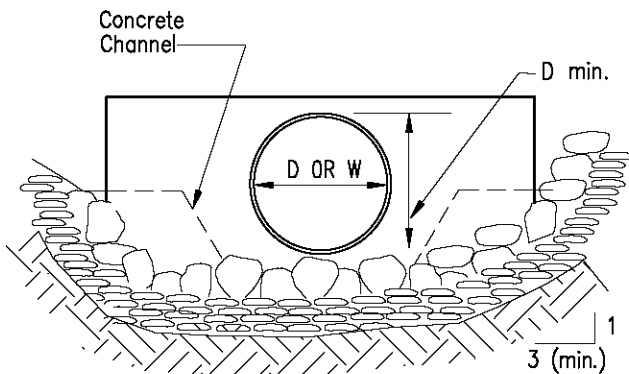
\*over 5.5 mps (18 fps) requires special design

D = Pipe Diameter

W = Bottom Width of Channel



SECTION A-A



SECTION B-B

#### NOTES

- Plans shall specify:
  - Rock Class and thickness (T).
  - Filter material, number of layers and thickness.
- Rip rap shall be either quarry stone or broken concrete (if shown on the plans.) Cobbles are not acceptable.
- Rip rap shall be placed over filter blanket which may be either granular material or filter fabric (woven filter slit film fabric shall not be used).
- See Regional Supplement Amendments for selection of filter blanket.
- Rip rap energy dissipators shall be designated as either Type 1 or Type 2. Type 1 shall be with concrete sill; Type 2 shall be without sill.

Revision	By	Approved	Date
ORIGINAL		Kercheval	12/75
Add Metric		T. Stanton	03/03
Add Rip Rap Table		S. Brady	04/06

#### SAN DIEGO REGIONAL STANDARD DRAWING

### RIP RAP ENERGY DISSIPATOR

RECOMMENDED BY THE SAN DIEGO  
REGIONAL STANDARDS COMMITTEE

*T. Stanton* 04/27/2006

Chairperson R.C.E. 19246 Date

DRAWING  
NUMBER

**D-4D**